The Glass Industry
REG. U. S. PAT. OFF.
Vol. 8 JULY, 1927 No. 7

# The Flow of Glass in Tanks

By D. J. McSwiney*

Knowledge of the lines of flow of glass in tanks is important inasmuch as this is one of the main factors determining the effective capacity of a tank, the rate at which a color or other batch change can be effected in the tank and the length of time during which subsequent streaking by the old glass takes place; also the tendency for the development of troubles due to the sloughing into the main glass stream of scummy materials or of old glass of a different "nature" from the colder or quieter parts of the tank.

The laws controlling the flow of water or of similar liquids through vessels are well known; however, these laws do not hold strictly in the case of a liquid, such as the glass contained in a tank, which is not physically homogeneous throughout.

The lines of flow—that is, the rate of motion of the liquid in various parts of the container—in a tank of glass vary with the construction of the tank and to some extent with the pull on the tank, but, in a tank of any definite type, the factor which determines the lines of flow to by far the greatest extent is the variation in viscosity throughout the tank. In any mass of moving glass which is not of the same viscosity throughout, the most rapid flow is always in that portion the viscosity of which is the lowest—that is, when the glass is chemically uniform, the greatest flow is always in the hottest portions. This principle holds not only for the flow of glass in tanks, feeders, etc., but it is also the basis of many forming operations, for example, the movement of glass in blowing a parison into the finished article in the blow mold.

Information as to the lines of flow of glass in tanks is obtained from observation of the flow while the tank is in use; from examination of the glass quarried from a tank which has been allowed to cool down without tapping and in which a color or batch change had been made; and by observation of the corrosion of the tank block by the glass.

Direct observation of the flow of glass in the tank by the movement of the melting batch materials ordinarily does not give much information inasmuch as, with the usual method of hand filling, the movement of the batch materials in the back of the tank may vary widely, not only with different tanks and tank men, but also with variations between the way two successive fills are made by the same man. Under normal conditions, the batch piles cannot be observed beyond one-half the distance to the bridge or floater as they are usually completely flattened out and mostly melted at this point, so that they give little evidence of the flow beyond the zone where the filling operation determines the movements of the glass. When the batch is filled in by means of a continuous feeding device, the apparent lines of flow of the batch are usually constant for each tank, but often vary greatly with different tanks; in some cases, the stream of melting batch flows straight down the tank for about one-third of the distance and then curls backward, while in other cases, the melting batch tends to accumulate in the rear of the tank either around the batch feeder or spreading throughout the back of the tank. During the operation of the tank, the lines of flow of the glass on the surface can be determined by observation of the movement of relatively large pieces of tank block or other difficulty soluble materials, but this gives little indication of the lines of flow of the glass below the surface. The flow of the glass in the refiner can also often be observed through the incoming glass being of a different temperature or color from the glass already in the refiner.

Evidence of the lines of flow of the glass can often be obtained from examination of the corrosion of the tank block; however, such evidence is unreliable with respect to the block near the metal line and can be of value in the case of the bottom block and the bottom courses only with flint or light green glass tanks, the ordinary tank being too deep to show any corrosion lines of flow with dark colored glasses, except in or near the bridgewall. It has been suggested that the vertical channelling of the side walls is due to the convection movement of the glass down the side walls, but it has been shown by Flint that these channels follow, and are in all probability the result of increased corrosion along cracks in the block. Observation of the glass in a large number of

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soda-lime glass tanks indicates that convection currents down the side walls seldom, if ever, occur in these tanks.

The best method of determining the lines of flow of the glass throughout the tank is by the examination of the glass quarried from a tank in which a color or batch change has been made. By the examination of the glass from tanks in which such changes have been made at different periods of time before the tank was let down, the rate of flow of the glass in different parts of the tanks can be determined. This, of course, can be done only in the case of those tanks in which the glass level has not been dropped when the tank is let down; the increasing practise of tapping tanks instead of quarrying out the glass, makes this method of examination less available than it used to be. Determination of the lines of flow in this way presupposes that during the cooling the relative position of the different parts of the glass mass do not change greatly through the development of convection currents during the cooling. That such convection currents do not develop, even when the tank of glass is cooled slowly, is shown by the fact that horizontal layers of glass of different color or layers of finely diffused opalescent scum show no distortion such as that which they would undergo if subjected to the movement of convection currents.

As the glass near the walls of the tank, or on the surface when the tank is cooling down, drops in temperature it increases in density and this increase in density tends to develop convection currents and to cause circulation of the glass. However, the tendency for the development of convection currents in a mass of molten glass is opposed by the high viscosity of the glass. In a soda-lime glass near the ordinary melting temperatures the increase in density with a drop in temperature is not nearly as great as the concurrent increase in viscosity, and it is to be expected that in such glasses the increased resistance to circulation offered by this disproportionate increase in viscosity would more than offset the tendency to circulation due to the increase in density. Moreover, in transparent glasses, local cooling of the mass of glass is hindered by radiation throughout the mass which tends to maintain all portions at the same temperature, and this action is greater the higher the temperature and, consequently, the more fluid the glass; in dark colored glasses, in which the transparency to the radiation is low, the temperature decreases rapidly and the viscosity increases rapidly with the depth, which, in itself lessens the tendency to circulation. However, that circulation does take place in some glasses which are very fluid at the melting temperature is shown by the observations of McCauley on circulation in a tank of pyrex glass.

As stated above examination of the glass quarried from along the side walls of a number of soda-lime tanks shows that circulation does not take place along these walls to any considerable depth; in tanks in which a change in color has been made, say from light green to flint or vice versa, a zone of the first color will very often be found against the side walls, sometimes extending to within a foot of the metal line and rapidly increasing in thickness with the depth, months after the change in color has been made; glass which has been filled in during the first weeks of the life of the tank is often to be found in the angle between the lower course and the bottom in considerable amount when the tank is dug out a year or more later.

When a radical change in color has been made during the life of a tank, very much more old glass may be found in the quiet parts of the tank. For example, a tank was started on flint glass and operated on this color for about three months, it was then changed to and operated for awhile on amber and subsequently on green; on quarrying out the glass, after being operated for fifteen months, a zone of each color was found in the quiet parts of the tank.

It seems probable, as suggested by Scholes, that some movement takes place in contact with the block, to a depth depending on the rate of temperature drop through the tank, due to the solution of clay in the glass having, as has been shown by Flint and Payne a density greater than that of soda lime glass, but this movement is extremely slow and has no influence on the lines of flow in the tank resulting from the pull.

As stated above, the factor which influences the lines of flow of glass through a tank to the greatest extent is the variation in viscosity throughout the tank. For this reason, the flow will vary with the composition and homogeneity of the glass and with variations in the distribution of heat throughout the tank, but the variable which exercises the greatest influence is that of color. Owing to the marked differences in radiant heat transmissibility of glasses of different colors, the lines of flow of glass of one color may differ greatly from those of another color, in the same tank.

The structure of a tank may undergo such changes during its life as to constantly change the lines of flow during this period, especially in the melter. This is the case with tanks equipped with throats, the opening of which is at or above the floor level at the usual depth and melting light colored glasses; the throats in such tanks undergo rapid upward corrosion, and as the main flow of the glass is along or near the upper portion of the throat, the upward corrosion in such cases causes the main flow of glass to constantly approach the surface. Aside from its beneficial effect on tank life, the use of the submerged (sunken or sump) throat in tanks melting light colored glasses is valuable in maintaining constant lines of flow through the tank during its life. The ordinary throat in a tank melting dark colored glass does not undergo sufficient upward corrosion during its life to materially modify the lines of flow. Some change in the flow during the life of the tank probably arises from the corrosion of the side walls increasing the heat loss through these parts and through variation in the heat distribution resulting from changes in the efficiency of the regenerators, etc.

The present crude method of intermittent filling of a tank by hand introduces the main variation from what might be expected as a normal flow in the tank. When a pile of batch is pushed into a tank, the pile does not move without disturbing the glass around it, but, instead, the glass in front of the pile is largely pushed forward, while that at the sides and especially from below is pulled in and up behind the pile. The effect of this oft repeated action is to cause a circulation in the rear of the tank in which the general direction of flow is towards the doghouse instead of towards the front of the tank. This rearward circulation often extends one-

third of the distance from the doghouse and the full width of the tank, causing some motion even in the corners of a tank of average width. As might be expected, the exact lines of this circulation varies in different tanks and with the different methods of filling used; in some cases, the batch is pushed to alternating sides of the tank on successive fills, in other cases, the fill is divided equally between the two sides of the tank, while in still other cases, the batch is scattered throughout the rear of the tank; each method of filling will vary the lines and the extent of this backward circulation but, in general, the zone of glass brought into circulation in the manner described has roughly the shape of a quarter spheroid.

This circulation in the rear of the tank not only has considerable effect on the rate of melting and plaining of the glass, but also is of importance in making color changes. The full effect of a color change in the batch will often not show in the doghouse samples until thirty-six hours or longer after the new color has been started in the tank; the reason for this is that before taking a sample from the doghouse, the tank man will usually push away with his bar any batch materials lying on the surface of the glass where he is to take the sample; the action of pushing away the surface materials brings up from below the surface glass which has not been recently melted, but which has on the contrary, been brought to the back of the tank by the backward circulation. This action is more evident in the case of dark colored glasses than it is with flint or light green and for the following reason: the circulation here is induced by the friction of the moving batch pile with the relatively viscous glass; in a flint or light green glass, there is only a relatively slight increase in viscosity in the first six or eight inches of depth, so that in this case, the glass at the bottom of the batch pile is only slightly more viscous than that of the surface, and the friction between the batch pile and the glass beneath it is only slightly more than with the surface glass; with the dark colored glass, on the other hand, a few inches in depth may mean a pronounced increase in viscosity, so that the friction in this case may be very much greater on the bottom of the pile than near the surface. The result of this is that the rearward circulation is much more rapid in a dark colored glass tank than in a tank of flint glass; on the other hand, this circulation is deeper in a flint tank than in a dark colored glass tank as below a certain depth the glass is too stiff to move in the latter case, while in flint tanks, the circulation, although slower may extend to the bottom. Doghouse samples are often to be seen which are entirely free from seed and unmelted matter—the presence of such glass at the point where the batch is filled in is due to the circulation towards the doghouse. Where two doghouses are used on a tank, the main effect appears to be to increase the amount of this rear circulation and to make it more uniform across the tank.

Where the more logical method of filling a tank by means of a continuous feeding device is used, this rearward circulation does not obtain to any extent. Some movement always takes place as a result of the contraction which the batch undergoes in melting, but this is very much less when the batch is fed into the tank in a continuous stream than when it is fed in large piles.

## Progress Made with Chromium Plated Molds

The possibility that a successful process might be developed for prolonging indefinitely the life of glass molds by coating them with an electrolytic deposit of chromium, was discussed in our August, 1926, issue. Considerable interest in the subject has been manifested in both the glass trade and in scientific circles.

Several investigations into the problem are being carried on in this country and Germany with results reported to be satisfactory. It is evident that the process is being seriously considered both because of the treatment adding enormmously to the life of the molds or other objects to which it is applied and because of the extraordinarily high polish given to the bottles and other products made with chromium plated equipment. The method has already obtained a foothold in this country, at least two and possibly more glass manufacturers are installing the electroplating equipment necessary for carrying on the process.

Patents have been issued in some instances on applications of the process to glass manufacturing equipment, and in other cases patent applications have been filed but not yet accepted. Through the courtesy of G. Dubpernell of Furnald Hall, Columbia University, we are able to give information of an application, for a British patent, made by German firms. Following is an abstract of the specifications as disclosed at the time they were opened to the public by the British patent office for examination.

**Process for the Manufacture of Molds or Tools Used in the Manufacture of Glass**

British Patent 254,330, June 25, 1925 (not yet accepted). Application No. 16,053, June 26, 1926. German Application, June 25, 1925. Glasfabrick A. G. of Brockwitz near Dresden, Germany, and Director Dr. Stein.

This invention relates to the manufacture of molds or tools used in the manufacture of glass.

One process according to the present invention consists therein that the molds used for instance for the production of glass or the tools used for the production of glass articles are "chromed," i.e., coated by a layer of chrome. In connection with the molds this chroming takes place after the patterns have been cut into the mold. The coating process by no means injures the fineness of the patterns cut into the molds; on the contrary the patterns will appear quite clearly and the upper surface of the mold in contact with glass material is of an extraordinarily high hardness equal to that of corundum. In consequence of this extreme degree of hardness neither the molds nor the tools wear so easily as has hitherto been the case. Consequently their life is longer and the costs for the manufacture of glass articles are correspondingly reduced.

Other patents relating to chromium plating are British

CHROMUM-PLATED MOLD

249,084, Metal & Thermit Corp. (K. W. Schwartz) re chromium plated lead-in wires, and U. S. 1,576,436, D. S. Gustin (Westinghouse Lamp Co.) covering same invention.

# Meeting of German Society of Glass Technology

By Dr. Bangert

The spring meeting of the German Society of Glass Technology brought together the members and friends of the Society at Weimar, in the heart of Germany, where Goethe passed the greater part of his life, who had the interest to occupy himself with the manufacture and the physical properties of glass. That this many-sided genius was concerned with this special field should not cause astonishment when it is considered that the glass industry of Thuringia, even at that distant time, could look back on an existence of several hundred years, which has given this region an importance reaching far beyond the boundaries of Germany.

GARDEN HOUSE IN THE CASTLE PARK, WHERE THE POET GOETHE LIVED. HE STUDIED GLASS.

IN THE PARK AT BELVEDERE CASTLE, NEAR WEIMAR. THE OPEN-AIR THEATRE OF OLDEN TIMES.

Weimar is a city of 46,000 inhabitants. It is one of many lovely places in Thuringia. It is a city of historical and cultural reminiscences which has gained world fame as the residence, from time to time, of some of Germany's greatest literary minds. Especially during the classic literary period of Germany, under the Grand Duke Karl August, Weimar was the center of the intellectual life of Germany. Goethe lived and worked there from 1775 to 1832.

Today, the city is the seat of the government of the Free State of Thuringia, has a large number of high institutions of learning, among them a music and an art academy, and several museums, art expositions and theatres. In 1919, the German National Assembly, which framed the new German constitution, was held in Weimar.

A large number of members of the Society arrived on May 18th in order to be present at the Committee meetings, held in the forenoon of the next day. The following committees met:

I The Committee for physics and chemistry of glass.
II The Committee for heat economy and furnace construction.
III The Committee for glass working machinery.

These meetings proved to be of the greatest interest, and the reports and discussions contained much of importance to the fundamental sciences and the technology of glass.

The remainder of the day was passed informally. In the afternoon a trip was made to visit the old Rococo castle Belvedere, where Professor Koehler, director of the State Art Institutions, acted as guide, and showed the valuable collection of old glass and porcelain, with the enthusiasm of the connoisseur. The exchange of ideas between him as art expert, with those experienced in the practical side of glass manufacture gave rise to many interesting discussions.

In the evening the members were assembled at an informal social gathering at the Hotel Fürstenhof, as guests of the Thuringia Society of Glass Manufacturers.

On May 20th, the President of the German Society of Glass Technology, Dr. M. von Vopelius, opened the meeting, attended by about 350 members, among them the honorary member of the Society, Dr. Otto Schott, of Jena. They were welcomed by the representatives of the State and by the officers of local business and industrial organizations. The papers presented were received with interest, and proved to be important contributions to the science and technology of glass manufacturing.

An exhibit of glass working machinery and equipment, showing the most advanced methods of glass manufacture, was held in connection with the meeting. The exhibits aroused great interest, and were a means of establishing closer contacts between glass makers and manufacturers of supplies and equipment.

It may be stated that the seventh meeting of the German Society was successful in every way.

### British and American Technologists Invited to Visit German Society at Aachen

An announcement of great importance to the American glass industry was made by Dr. Gehlhoff of Berlin, to the effect that the next spring meeting of the Society in 1928 will be held jointly with the British Society of Glass Technology and with the American Ceramic Society, in connection with the proposed European trip of the A. C. S., scheduled for the spring of 1928. This meeting will be held at Aachen, one of the centers of the European glass industry.

## Abstracts of Papers Read at Weimar

### The Plate Glass Process of Bicheroux

By Dr. A. Wendler, Berlin

For practical reasons it is impossible to roll rough plate glass to be used for the manufacture of polished plate glass, in sheets of less than 11 millimeters in thickness. This is so, because while working up the contents of a pot of the usual size, the part which is rolled first becomes too cold, and may crack before the part which is rolled last has become solid enough to be put into the annealing furnace. For this reason thin, polished plate glass of about 6 millimeters in thickness is more expensive than heavier plate, since the former requires more grinding and polishing than the latter. To overcome this difficulty, Bicheroux has developed a process

By courtesy of the German Society of Glass Technology, Frankfurt a/M.

by which a thinner sheet of glass, with a corresponding larger surface, is rolled out, and at the same time is cut into smaller parts, while still in the softened condition. These smaller plates are then quickly removed to the annealing furnaces.

Since this process showed some inherent shortcomings, Bicheroux, after the interruptions caused by the war, took up his endeavors to further improve the process, with the bold aim in mind of pouring out at one time the entire content of a glass pot in a rolling mill and rolling it out. The difficulties connected with such a procedure will become apparent when it is considered that present day glass pots used in plate glass manufacturing contain 1,000 liters, and that the rolling out of such a quantity to a thickness of 6.5 millimeters will give a yield of 75 square meters of usable glass.

This difficult problem has been solved by adjusting an approximately horizontal table before the slit of the rollers, which measure about four meters in length. After the molten glass has been poured out, the table overturns slowly, so that the glass mass enters between the rollers. The apparatus and the quality of the glass obtained has been greatly improved through a newly invented crane, which makes it possible to tip over the glass pot in such a manner that the glass mass is poured out much more quietly.

For the purpose of receiving the glass plates coming forth from the rolling mill, the transportation tables usually employed in connection with smaller rolling works proved to be unsuitable. Therefore the rollers have been provided with a rippling device and the transportation tables with ripplings, running diagonally across, so that the rippled glass ribbon touches the iron basis only in points where the glass ripples meet the table ripples. The result is an almost perfectly smooth surface, free from coldcracks.

The advance which this new process embodies is very remarkable. The same amount of molten glass yields twice the surface of rough plate as compared with the older processes, without increasing the amount of work required for grinding and polishing. Only half of the thickness has to be polished off to obtain a perfectly smooth surface. For this reason, this process is arousing great interest and following the first installation in Herzogenrath, further factories are being built or are planned both on the continent as well as in the United States.

## The Sillimanite-Mullite Problem

BY DR. W. EITEL, BERLIN-DAHLEM

In the system alumina-silica, which is of such great importance to ceramics, there occur several aluminum silicates, according to our present views. Besides the natural silicates, andalusite, kyanite and sillimanite, other crystalline compounds between alumina and silica have been made by synthetic meltings. These products resemble sillimanite, and according to American investigators they have the composition $3\,Al_2O_3\,2SiO_2$. This material is called mullite, and it is remarkable on account of the fact that in spite of its difference in composition from sillimanite, it is very similar to the latter as regards crystallographic and physical properties.[1] According to the latest investigations this similarity even applies to its intimate structure as revealed by X-rays. This case, which up to the present has remained unique, may be explained by the great tendency of the endothermic molecular compound to become dissociated. In consequence there are formed at temperatures near the melting point an amorphous phase, rich in silica (glass) and a very finely divided crystalline embedded phase of alumina in sillimanite. The latter is called mullite.

This explanation does not affect in any way the technical importance of the properties, discovered by American scientists. On the contrary, the finely divided nature of the mullite, as compared with sillimanite explains its superior mechanical and chemical properties.

For the glass industry the mullite problem is of great importance, since this kind of crystal is always formed in tank blocks, that are in direct contact with molten glass. The mullite substance is highly resistant against the corrosive action of molten glass. This explains the existence of the thin layer which is formed through the action of glass on the tank blocks, and which protects the latter from rapid deterioration. The realization of this fact has been the cause of the manufacture of tank blocks rich in mullite, which are now being produced, and which have proved their value. Especially interesting is the experiment, recently made in the United States, to cast tank blocks directly from mullite. Such blocks are of course especially advantageous on account of their close structure, and their life is therefore greatly increased. However, it remains to be seen if the high cost of such mullite blocks will not prevent their general use. For parts of the tanks which are especially exposed to the corrosive action of molten glass, these blocks will undoubtedly prove to be very useful.

## The Problem of the Nature of the Glassy State

BY DR. E. BERGER, JENA

Not until the past fifty years has there been any discussion as to the nature of the glassy state. The conception has finally been formed that glass is an extremely viscous, amorphous, undercooled solution. This answer to the question, however, has been modified and enlarged through recent investigations. As a result of the new conceptions we now have the view that glass passes through three phases, depending on the existing temperature, namely, the liquid, the viscous and the brittle state. The viscous phase is bounded by the higher and lower temperature limits, which are further explained through researches regarding changes in viscosity and the modification of certain properties during the change from the brittle into the viscous phase.

The deeper cause of these transformations lies in the fact that glass contains compounds which are easily polymerized. The changes in the molecular structure, characterizing the three phases, were further explained. Especially the dependence of the properties of glass on its previous history was emphasized.

Finally a review of the enlarged conception of the glassy, amorphous state was given, and a classification of the various glasses was proposed into irreversible and reversible, organic and inorganic, and into glasses consisting of allotropic elements or compounds and those consisting of complicated solutions.

[1] Bowen and Grieg have shown that there is only one compound of alumina and silica stable at high temperatures, namely, mullite, which has the composition $3Al_2O_3\,2SiO_2$, while the composition of sillimanite is $Al_2O_3\,SiO_2$.—EDITOR.

## Automatic Regulation of Gas Pressure in Glass Works

By Dr. W. Friedrichs, Stützerbach

For efficient management of glass works, the regulation of gas pressure is of great importance. The advantages of pressure gas-producers are not completely utilized since much gas is wasted through irregularities of pressure. Besides, lack of pressure constitutes an ever-present danger. Regulation by hand is unsatisfactory, due to the fact that the personnel and apparatus are not dependable. Various forms of self-regulating apparatus may be classified according to whether the energy derived from the variation of pressure is used directly to act upon valves (membrane or bell-regulators) or whether they act on regulating devices. To put heavy valves into operation by means of slight changes in pressure would require apparatus of gigantic proportions, and moreover, they would act too slowly. For regulation of gas pressure in glass works, only the second form of regulation can be considered.

For the theoretical treatment of the problem, it is of importance to know whether the speed of regulation varies in proportion to the magnitude of the pressure variation, or whether the speed is constant. Theoretical considerations show that regulation with constant speed gives a more exact regulation, but the compensation is inadequate in case large and rapid fluctuations in pressure occur. Regulators whose speed conforms with the variation in pressure act more efficiently, but they are too slow at the limits of sensitivity of the apparatus. An ideal arrangement would be a combination of the two systems.

Not only the air pressure should be regulated, but the steam pressure as well. With proper design of the regulating valves this can be effected with one regulating device. If the pressure is regulated entirely by means of the steam supply, regulation of both air and steam pressures is possible through a side valve in the main steam line. This results in an even moisture content of the air. The saving of coal effected through proper regulation of pressure amounts to about ten per cent.

## Gases in Glass

By Dr. H. Salmang, Aachen

The evolution of gases during melting of a clear glass, and during the refining of glass in industrial glass melting furnaces has heretofore been explained as being due to the expulsion at high temperatures of gases, which are held dissolved in glass. In order to study this phenomenon, a number of soda-lime glasses were tested with reference to their gas content, following a method developed for the extraction of gases from metals by scientists connected with the Institute of Metallurgy of the Technical University of Aachen. The apparatus was modified in such a way that a platinum crucible could be heated to 1,400 deg. C. in a closed tube. The gases, which were removed by the use of a vacuum of 0.001 mm. mercury, were freed from moisture with phosphorus pentoxide, acid gases (carbon dioxide and sulphur dioxide) were removed with liquid air, and the oxygen was eliminated by combustion with pure hydrogen. The remaining gas was considered to be nitrogen. The increase in pressure after removal of the liquid air gave the volume of the acid gases, which were tested for $SO_2$ in the usual manner. The melting process could be observed directly, so that the slightest evolution of gas could be noticed. The results showed that even long continued heating at 1,400 deg. C. did not suffice to remove all of the gas. It was found that an equilibrium is reached for each temperature, which can be upset by increasing the temperature, causing again a strong evolution of gas until a new equilibrium is established at the new temperature. From the escape of gas at 1,400 deg. C. it could be concluded that the evolution would not be complete until extremely high temperatures have been reached. According to the temperatures of the experiments, the gases extracted from the glass had a volume measuring from one to two times the volume of the glass. They consisted of about three-fourths carbon dioxide, some oxygen and some nitrogen, which were probably diffused into the apparatus from the surrounding air. A saltcake-lime glass acted differently from a soda-lime glass, in as much as the evolution of gas was much more energetic. The points of equilibrium at increasing temperatures were more sharply defined and the gases formed were principally sulphur dioxide and oxygen, in the proportion 1 $SO_2$ to ½ $O_2$. This proportionality of the gases and the formation of foam during their evolution can be explained as follows: The gases are probably not dissolved in the glass, but are formed during the heating under reduced pressure by decomposition of certain compounds, present in the glass, such as sodium and calcium carbonate, and sodium sulphate. The presence of the latter substance in sulphate glasses is probably due to the content of sulphur trioxide, which may be as high as one per cent. Even at high temperatures and low pressures, and in the presence of an excess of silica, the sulphate compounds are not completely decomposed. This could be proved by experimental melts of salt cake and a salt cake and silica. The decomposition of sulphate yields sulphur trioxide, which under the conditions of the experiment must be decomposed into sulphur dioxide and oxygen. The increase in volume caused thereby tends to produce a strong formation of foam, which may, however, also be due to differences in the viscosity. The sodium oxide, formed by the decomposition of salt cake or soda ash probably combines at once with silica.

The hypothesis that the gases are not dissolved in glass, but are present only as chemical compounds which are dissociated by heating, must be supported by experiments having the object to cause solution of gases in glass. To accomplish this, samples of soda-lime glass, previously completely freed from gas, were heated at temperatures ranging from 1,000 deg. to 4,000 deg. C. under atmospheric pressure in the presence of carbon dioxide and nitrogen for several hours. They were then quickly brought into a high vacuum. In no case was there any evidence of the evolution of gas bubbles, so that the insolubility of gas in glass may be considered as proven. Experiments with glasses of different composition and with other silicates are being continued.

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Other papers presented at the Weimar meeting in May were The Development of the Thermometer Industry of Thuringia, by Dr. H. Fischer, of Ilmenau, and the Physical and Chemical Properties of the System: Soda—Potash—Lime—Alumina-Silicate, by Dr. F. Berger, of Jena. These will be reviewed in a later issue.

# Displacement of Labor by Machinery in the Glass Industry

**From the Monthly Labor Review of the U. S. Bureau of Labor Statistics**

*(Concluded from the May issue)*

Bulletin 441, "Productivity of Labor in the Glass Industry," mentioned on page 110 of the May issue, will contain more than 200 pages, crammed full of description, data and discussion of the glass industry, principally manufacturing operations, with particular reference to the cost and productivity of labor in this industry as affected by the introduction of machinery.

The investigation upon which this report is based was authorized by the United States Department of Labor, James J. Davis, secretary, and was conducted by the Bureau of Labor Statistics, Ethelbert Stewart, Commissioner. The bulletin was prepared by Boris Stern of the latter bureau, who evidently spent a great deal of time and an enormous amount of energy in the collection of information and preparation of this voluminous report of facts and statistics pertaining to the subject of the investigation.

Mr. Stern visited scores of glass factories and has thoroughly familiarized himself with all of the principal glass making operations as carried on today. He has compared them with former methods and treats of the effects of the introduction of machinery into glass-making processes from the time when mechanical inventions were first applied to the production of glass down to the present.

The exact date on which the bulletin will be issued by the Bureau of Labor Statistics has not been learned, but it is understood that copies will be available very soon. They will be obtainable through the United States Government Printing Office, Washington, D. C.

A large part of the material contained in the accompanying article was taken from matter prepared for Bulletin 441, which in reality is a more extensive treatment of the same subjects.

## Output and Productivity

From the labor standpoint, the most important change directly connected with the introduction of machinery in the glass industry has been the increase in output per wage earner employed. Table 3 shows a comparison of output per man in the four principal branches of the glass industry in 1899 and 1925. As there shown, the increase in 1925 over 1899 was greatest in the case of bottles and jars, 338 per cent; and lowest in the case of plate glass, 101.3 per cent.

TABLE 3.—YEARLY OUTPUT PER MAN IN SPECIFIED BRANCHES OF THE GLASS INDUSTRY, 1899 AND 1925.

| Branch of industry | Unit | 1899 | 1925 Quantity | 1925 Per cent of increase over 1899 |
|---|---|---|---|---|
| Bottles and jars | Gross | 274 | 1,200 | 338.0 |
| Pressed and blown ware | Pieces | 28,694 | 91,272 | 218.1 |
| Window glass | Boxes | 500 | 1,359 | 171.8 |
| Plate glass | Square feet | 5,240 | 10,551 | 101.3 |

In the figures for the separate branches of the industry there exists a slight error, due to the fact that the hours worked per day in 1899 and 1925 are not strictly comparable. For instance, in the bottle industry the regular hours of work were eight and one-half in 1899 and only eight in 1925. On the other hand, in 1899 nearly all the plants, following a long-established custom, suspended production for a period of two months, while in 1925 only a few plants stopped producing for a month or more, because of repairs or the usual reconstruction of tanks, which must be done every 12 to 18 months. Similar or somewhat different discrepancies in the hours worked also exist in the other branches of the industry, but their general effect on the output was so slight as to exert very little, if any, influence on the validity of the figures of productivity given.

## Value of Output

In 1899, the 7,780,000 gross of bottles and jars produced were valued at $21,677,000, an average of $2.79 per gross; in 1925, the value of the 26,044,000 gross produced was $100,301,000, an average of $3.86 per gross, and an increase of 38.4 per cent over the average value of 1899. In the pressed and blown ware branch of the industry, the 360,000,000 pieces produced in 1899 were valued at $17,076,000, an average of $4.74 per hundred pieces. In 1925, the 1,963,000,000 pieces produced were worth $72,085,000, making the average $3.67 per hundred pieces, or 22.6 per cent lower than in 1899. In the window-glass branch, the 4,341,000 boxes produced in 1899 were valued at $10,879,000, an average of $2.50 per box. In 1925, the 11,343,000 boxes were worth $37,525,000, an average of $3.31 per box, or 32.4 per cent higher than in 1899. In the plate-glass branch, the 16,884,000 square feet of polished glass produced in 1899 were worth $5,159,000, making the average $30.56 per hundred square feet. In 1925, the 117,369,000 square feet produced were worth $57,207,000, an average of $48.74 per hundred square feet, which is 59.5 per cent higher than the average of 1899.

Table 4 compares the trend of these average values in the four branches of the industries, and of wholesale prices of manufactured commodities, from 1899 to 1925.

In average unit values each branch of the industry seems to have a trend entirely different from any other branch, due to conditions inherent in that branch. For instance, window glass and plate glass as building materials are largely affected by the general conditions in the building industry. This accounts for the drop in their values in 1909 and the steep rise in 1919, as compared with the value of bottles and jars or of pressed and blown ware. Again, for a number of years plate glass has been in great demand for the automobile industry, and in 1921, in spite of the depression in the other branches of the glass industry and in the wholesale price index of manufactured commodities, the value of plate glass continued to rise through 1923, when the introduction of the continuous process began to exert its influence and values began to drop.

On the whole, however, the general trend of the four branches of the industry is unmistakably downward, and, with the exception of plate glass, none of the average unit value indexes rose during the period above the wholesale price index of manufactured commodities.

TABLE 4.—AVERAGE UNIT VALUES OF PRODUCT AND INDEX NUMBERS THEREOF AND OF WHOLESALE PRICES OF MANUFACTURED COMMODITIES IN SPECIFIED YEARS, 1899 TO 1925

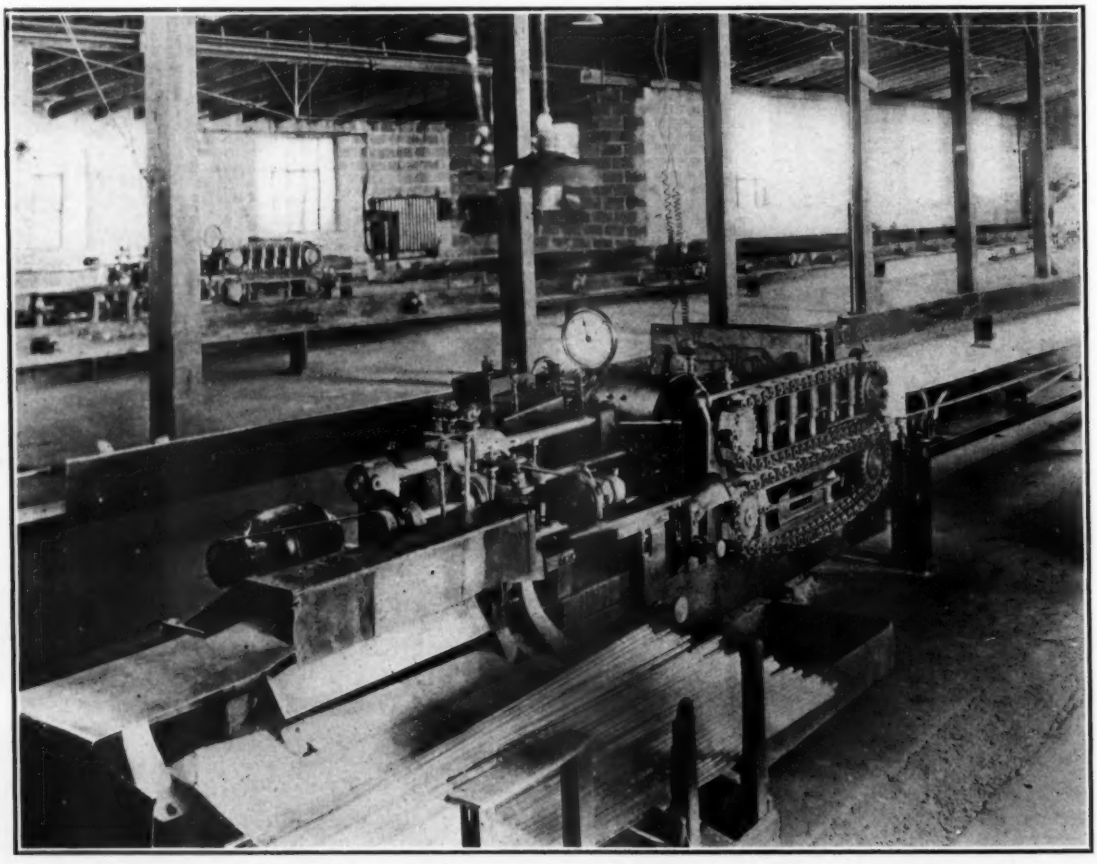
| Year | Average value of product | | | | Index numbers of— | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Average value of product | | | | |
| | Bottles and jars (per gross) | Pressed and blown ware (per 100 pieces) | Window glass (per box) | Plate glass (per 100 square feet) | Bottles and jars | Pressed and blown ware | Window glass | Plate glass | Wholesale prices of manufactured Commodities[1] |
| 1899 | $2.79 | $4.74 | $2.50 | $30.56 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |
| 1904 | 2.80 | 5.13 | 2.40 | 29.23 | 100.0 | 108.2 | 96.0 | 95.6 | 109.8 |
| 1909 | 2.93 | 5.15 | 1.70 | 25.78 | 105.0 | 108.6 | 68.0 | 84.4 | 124.6 |
| 1914 | 2.70 | 4.33 | 2.18 | 24.47 | 96.8 | 91.4 | 87.2 | 80.1 | 128.7 |
| 1919 | 4.25 | 6.54 | 5.57 | 58.68 | 152.3 | 138.0 | 222.8 | 192.0 | 273.4 |
| 1921 | (2) | (2) | 4.61 | 66.25 | .... | .... | 184.4 | 216.8 | 188.2 |
| 1923 | 3.78 | (2) | 4.18 | 69.96 | 135.5 | .... | 167.2 | 228.9 | 188.7 |
| 1925 | 3.86 | 3.67 | 3.31 | 48.74 | 138.4 | 77.4 | 132.4 | 159.5 | 203.3 |

[1] Recomputed from indexes given in U. S. Bureau of Labor Statistics Bul. No. 415, p. 31.
[2] Not reported.

### Wage Workers' Earnings

A comparison of rates of wages in the glass industry in 1899 and 1925 is of no significance, for the reason that the nature of the work done and the kind of labor used in 1925 were entirely different from the work done and the labor used in 1899. Twenty-five years ago the majority of workers employed in the industry consisted of highly-skilled blowers, pressers, finishers, gatherers, flatteners, and cutters, and unskilled mold boys, snapping-up boys, warming-in boys, carry-in boys, carry-over boys, and the like. In 1925, only a small percentage of such labor had been retained even in the hand plants. The new class of glass workers is made up of tank men, machinists, machine foremen, machine operators, and helpers, with little if any preliminary training in handling machines. Again, in 1899 all skilled workers were paid on a piecework basis, while in 1925 the overwhelming majority of workers were paid on a time basis—by the hour, by the week, or by the month.

It is possible to compare the yearly earnings of the wage earners in 1899 and in 1925. In 1899 the 52,818 wage earners in the industry received a total wage of $27,084,000, an average of $512.78 per wage earner per year. In 1925 the 69,371 wage earners received a total wage of $86,736,000, an average of $1,250.32 per wage earner per year, or nearly 2½ times as much as in 1899. But in making these comparisons it must be remembered that the group of wage



THE DANNER AUTOMATIC TUBE DRAWING MACHINE, WHICH IN A FEW YEARS DISPLACED PRACTICALLY ALL "HAND BLOWERS" IN THE TUBING FIELD. *Reprinted from a previous issue.*

earners in 1899 contained a large percentage of workers under 16 years of age, with extremely low wages; whereas in 1925 the number of minors under 16 years was practically nil. This difference would tend considerably to depress the average earnings per man in 1899 as compared with 1925. On the other hand, many of the skilled workers in 1899, working on a piece-rate basis, were earning exceptionally high wages. Fifty to seventy-five dollars a week was not an exceptionally high wage for a skilled bottle or window-glass blower in those days. In 1925 this extreme had also been eliminated.

### Child Labor in the Industry

Prior to the introduction of machinery, the glass industry was one of the greatest exploiters of child labor. This was particularly true of the bottle and pressed and blown ware branches, for very few children had ever been employed in the making of window glass and none in plate glass. In 1899, of the total of 40,916 wage earners employed in making bottles and pressed and blown ware, 7,035, or 17.2 per cent, were children under the age of 16 years. These were employed chiefly as mold boys, cleaning-off boys, and snapping-up boys in the furnace room, and partly as burning-off girls, glazing girls, and selectors in the finishing department.

The conditions under which the children were employed are fully discussed in the Commissioner of Labor's Report on Condition of Woman and Child Wage Earners in the Glass Industry in the United States made at the request of the United States Senate and published in 1910. The following quotations are from this report. Referring to the work of the mold boy it says:

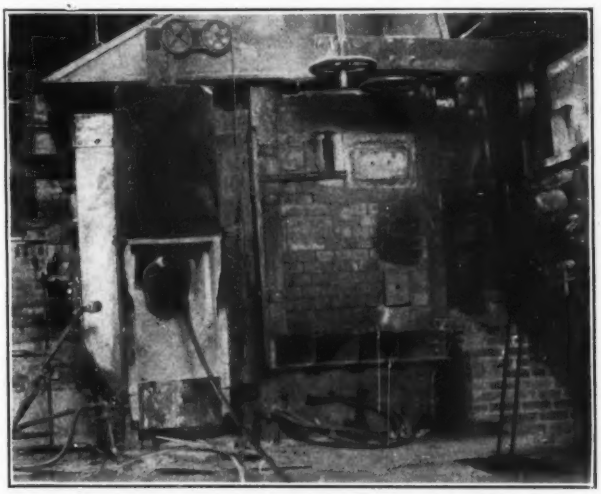
The mold rests upon or very close to the floor. As a result the mold boy must either squat upon the ground in an awkward, cramped position * * * or, standing, must stoop constantly to his work. When the mold boy must thus sit with his legs doubled under him, or sitting on a crude chair or box, stoop over almost to the floor to operate the molds, the occupation becomes one which, continued for any great length of time, undoubtedly tends to dwarf and deform the child.

He must necessarily be close to the mold, and for speed of working the mold is placed near the furnace, directly in front of the working hole and some 3 feet below the level of the hole. As the mold tender works he faces the furnace, and his face and shoulders at least are in direct line with the radiated heat from the working hole. In addition to the furnace, there are other sources of heat adding to the boy's discomfort: The blower in lowering the hot lump of glass into the mold necessarily swings it close to the boy's face; the mold itself, after a short using, becomes very hot and gives off considerable heat; in some factories the "glory holes," at which the finishing work is done, are crowded close to the furnace, and little space left between them and the mold boys (p. 48).

The heat conditions in the furnace room are thus described:

The generally accepted figures of the heat within a furnace during the "fusing" is 2,507° F. between the pots and 2,390° F. in the metal itself. These temperatures are reduced when the holes are opened for working to a standard of 1,913° F., although glass is commonly worked at a temperature of a hundred degrees less than these figures.

Factory No. 2 was examined June 18, at 12.25 p.m. with the outside temperature at 90°. The temperature taken at a point two feet from but directly in front of a working hole showed 142°, two others taken the same distance from but slightly to the side of the holes showed 135° and 137°. Temperature near cleaning-off boy, 105°; near the mold boy 113°; in front of the "glory hole," 116°; at finisher's bench, 104°; where snap-up boy stands to rub excess glass off neck of bottle, 103°; where carry-in boy picks up ware, 98°; in front of lehr, where carry-in boy stands to deposit ware, 125°.



MELTING AND DRAWING TANK, DANNER PROCESS.

In warmer weather the ill effects of the heat show themselves directly in the form of prostration or affections directly due to the high temperature. In the winter the immediate danger to health arises from sudden changes in temperature. The boys, as a rule, have little or no extra clothing to protect them from the outside weather and rarely take the trouble to wait in the factory until their bodies are sufficiently cooled to bear the change. The danger is particularly acute when night work is being done.

With the introduction of machinery in the industry the child-labor situation changed. The mold boys, the cleaning-off boys, and the snapping-up boys were at once dispensed with, even in the case of the cruder and semi-automatic machines. The job of the carry-in boys was retained for some time, but the introduction of the Owens automatic machine, with its automatic conveyor, eliminated all the work formerly done by child labor. Even where no conveyors have been installed and the job of the carry-in boys has been retained, the output of the machines has proved to be too large to be handled by minors, and the job, though retaining the name of "carry-in boys," is actually performed by an adult unskilled man or woman.

Table 5 gives the total number of wage earners and of children under 16 years employed in the industry from 1880 to 1919, the last year for which figures are available from the census reports:

TABLE 5.—NUMBER OF WAGE EARNERS AND OF MINORS UNDER 16 YEARS EMPLOYED IN THE GLASS INDUSTRY. BY SPECIFIED YEARS, 1880 TO 1919.

| Year | Number of wage earners | Minors under 16 years — Number | Minors under 16 years — Per cent of total wage earners |
|---|---|---|---|
| 1880 | 24,177 | [1] 5,658 | 23.4 |
| 1890 | 44,892 | [1] 6,943 | 15.5 |
| 1899 | 52,818 | 7,116 | 13.5 |
| 1904 | 63,969 | 6,435 | 10.1 |
| 1909 | 68,911 | 3,561 | 5.2 |
| 1914 | 74,502 | 1,992 | 2.7 |
| 1919 | 77,520 | 1,413 | 1.8 |

[1] Males under 16 years and females under 15 years.

From 1880 to 1899 the number of minors under 16 years increased from 5,658 to 7,116, but this increase was not so fast as that of the total number of wage earners in the industry. The percentage that minors formed of the total number of wage earners decreased therefore from 23.4 to 13.5, though the actual number increased 25.7 per cent.

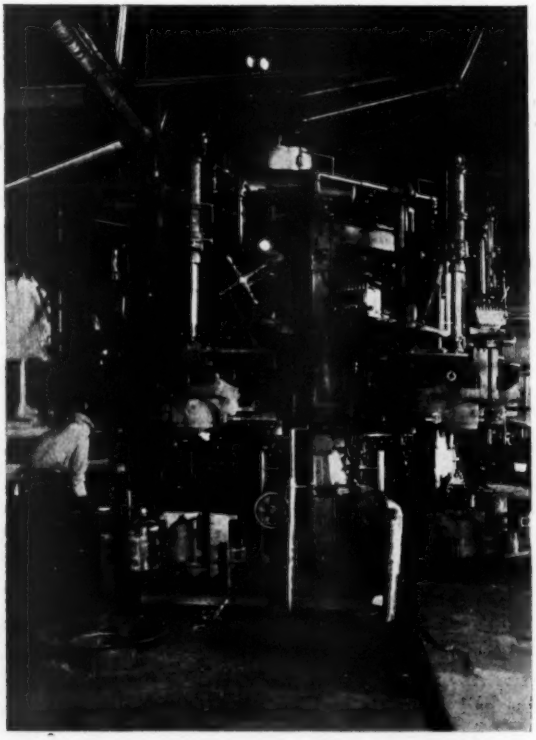
Beginning with 1904, both the actual number and the percentage minors formed of the total decreased, while the total number of wage earners continued to rise rapidly. In 1919, the last year for which official figures are available, there were 1,413 minors, only 1.8 per cent of the 77,520 wage earners in the industry. Child labor in the glass industry has now become almost a matter of the past, and credit for this is due in no small measure to Michael J. Owens, the inventor of the Owens machine. As a boy of ten, in 1869, he joined the ranks of the thousands of children employed in the glass factories. He died in 1923, the genius of the glass industry, whose inventions contributed more than all other factors combined to the complete elimination of child labor from the industry.

# The Big Bertha of the Bottle Works

**Not Iron Mountain—nor Stone Mountain—but Glass Mountain. Here it is—a pyramid built like the Cheops—but in less time—with 6194 five-gallon bottles participating in its construction.**

**Thirty tons of glass are resting on the bottles in the bottom layer of this pyramid. Figure it out for yourself—the bottles weigh eleven pounds apiece. The contact throughout is glass on glass—with the bottoms of one row resting on the shoulders of the one beneath.**

**Although as large as an ordinary house this pyramid represents only part of a single day's production on the carboy machine of the Illinois Glass Company at Alton, Illinois.**



**In the old "hand-blown" days it took about all the chest expansion a skilled glass blower had to produce two hundred five-gallon bottles a day. The iron cheeks of this carboy machine, however, are tireless. They puff and blow 7500 to 8000 big bottles in 24 hours without a particle of strain or discomfort. The capacity of this largest of all bottle blowing mechanisms—the only one of its kind in the world—is sufficient to take care of the demand of the entire country for wide mouth and narrow mouth big bottles for pharmaceutical, laboratory, storage and packing purposes, and for the bottling of spring water.**

*—Courtesy of Illinois Glass Company*

# Second Hearing on Plate Glass Production Costs

## Counsels' Briefs Filed: Increase of 41.6 per cent. in Duty Asked

In the June issue the testimony at the second hearing on plate glass costs of several witnesses in favor of the applicants for lower duties on glass was reviewed, the report closing with Louis Roth of New York still on the witness stand. After the conclusion of his testimony and that of Lucian DeBay on the following day, the opposition witnesses were heard at subsequent sessions and the hearing terminated.

The Commission set Monday, June 13, as the date for exchanging briefs by counsel and filing them with Secretary Bethune of the Commission, and allowed until Monday, June 27, for filing replies to the briefs, all to be taken under consideration by the Commission in reaching their decision in the case, which will not be announced, it is expected, until a considerably later date.

### Recommends Increase of 41.6 Per Cent in Duty

The brief submitted to the Commission just as this issue was going to press, by Royal T. McKenna and Alex Koplin of Washington, D. C., in behalf of their clients, American Plate Glass Corporation, The Edward Ford Plate Glass Company, The National Plate Glass Company, and Standard Plate Glass Company, is a 60-page book stating the origin of the case, outlining the statutes involved, the duties of the Commission, and quoting with lengthy comments some answers made by witnesses to the questions propounded by the Commission in its preliminary statement. It discusses the objections of foreign manufacturers to the facts reported by the Commission, calls attention to the effects of foreign importations on the American jobbers of plate glass, points out the objections of American manufacturers to consideration of results of operations of certain companies in handling other commodities than plate glass, and finally recommends that the duty shown in each of the three brackets of Paragraph 222, Title I, of the Tariff Act of 1922 be increased by 41.6 per cent.

The brief argues that no evidence has been introduced warranting a change in any of the proposed findings of fact shown in the Commission's second preliminary statement; that the basis suggested by the American manufacturers for computing transportation costs is proper; that no landing charge should be included at any of the ports; that these recommendations logically point to a finding that the average differential in favor of the Belgian producer is 22.52 cents per square foot.

The weighted average duty under the Tariff Act of 1922 is 15.9 cents per square foot. If the present duties were increased in the amount necessary to equalize the difference of 22.52 cents per square foot in costs of production an increase of 41.6 per centum would be necessary. This would result in the following rates of duty applicable under the three brackets of paragraph 222:

| | |
|---|---|
| Up to 384" | 17.7 cents per square foot |
| 384" to 720" | 21.24 cents per square foot |
| Over 720" | 24.78 cents per square foot |

The above computation is based on the weighted average duty of 15.9 cents per square foot applied to exports from all countries.

The American manufacturers contend that if this recommendation is not adopted the only other proper way to apply this difference in costs of production to paragraph 222, Title I, of the tariff Act of 1922, would be to grant the full increase permitted by Section 315 of 50 per centum on the first two brackets and the maximum increase permissible on the last bracket which they believe to be 23.6 cents per square foot. The basis of this computation is shown in the brief.

Briefs filed by the representatives of the foreign manufacturers were not available at the time this issue went to press.

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### Further Examination of Witnesses

A lengthy and interesting discussion took place on the subject of freight rates and the question as to whether interest should be charged as a production expense.

Mr. Roth maintained that interest is not a part of the cost of production. He said:

"Interest is treated by accountants as a distribution of profit. Now, that is true of interest paid, not only imputed interest, which is shut out entirely by accountants, but interest paid. Now, the reason for it is that some companies may have no indebtedness, no bonded indebtedness, as, for instance, one of the largest producers in this country. They would have only stock, and there is no question but that the profit to be distributed in the form of dividend profit, is income, and not a cost of production.

"Now, if you take another company that has not only stock but has bonds, the return on some of the money of the one company invested in stock would beyond any question be profit, and in the other company it would be paid in the form of interest as a fixed charge and should similarly be treated as profit distributed to investors in bonds. That is their income on their investment in the form of bonds similarly as the dividend paid to the stockholders is income from his investment in stock."

MR. MCCUMBER: "Now, let's see about that to follow it out. Suppose a company starts in business and borrows a million dollars to erect its plant and issues its bonds for a million dollars bearing 6 per cent interest; in computing cost of producing in that particular plant would you not really be compelled to consider what you had to pay out in the form of interest?"

MR. ROTH: "For comparison of costs of production in one plant with those of another you would shut out interest paid on the bonds.

MR. ROTH: "It would be included by accountants in any event, even without comparison. Interest is considered as a deduction from income and shown in the income section of the profit and loss statement, and certainly for comparative purposes it would not be included as a cost of production."

MR. MCCUMBER: "Then another company doing business in the same way, and perhaps having already paid for their plant and having no bonded indebtedness, its cost of production would be considerably less than it would be in the company carrying a heavy interest charge?"

MR. ROTH: "It would not if you would exclude the interest paid in the one company of which you have been speaking previously, and therefore they would be placed on a parity. And that is exactly the reason why interest paid is excluded from cost calculations."

The next witness called was Lucien DeBay, managing director of the Auvelais Plate Glass Company, of Auvelais, Belgium.

Mr. DeBay answered a number of questions regarding the best period to use in determining production costs, and favored the year 1925. He explained the methods employed in Belgium in buying raw materials and supplies from other countries, much

of which must be paid for in advance so that large funds are tied up for a long time before the raw materials are made up into plate glass. He gave considerable information regarding discount rates and other financial operations in Belgium. He stated that the property value allowed by the United States Tariff Commission in calculating imputed interest was much lower than the value fixed by the Belgian government for tax purposes. In the case of his own plant, the value accepted by the Tariff Commission for 1925 was $680,000 and the Belgian government valuation for tax purposes was over $2,000,000 for the same year. He said that to rebuild the factory under present conditions would cost twice as much as the Belgian valuation.

Mr. DeBay testified that the Belgian Government had put into effect an export tax of 2 per cent on the invoice value of plate glass shipped to foreign countries, including the United States. The tax went into effect December 1, 1926. The law went into force five years ago but up until December 1, 1926, plate glass was excepted.

MR. RAFTER. "Do you know whether or not the United States Tariff Commission included under the item of selling expenses in the case of the cost of production of Belgian factories, members of the Belgian Union, all of the selling expenses?"

MR. DEBAY: "It was very difficult to find out what has been charged, but I was told by the Union that all of the selling expense had not been taken into consideration. The Union finds that the selling expenses of the Union are higher than were included here in the cost price."

COMMISSIONER COSTIGAN: "Mr. DeBay, you have different selling expenses, one for the Union, one for your agent at New York, and one for your plant?"

MR. DEBAY: "We have selling expense in all plants. You see we have to pay the Union and then the Union has itself all the officials, all the expenses of the officers, and then they have to pay the agent in New York."

Mr. Rafter called the attention of Mr. DeBay to Table 29 of the Commission's statement of information showing losses in manufacturing plate glass in the United States to be approximately twice the amount of such losses in Belgium. Mr. DeBay explained that the reason is the difference in the yield of the American factories gotten from labor, twice as high as the Belgian, so he thinks that the American workmen cannot give the same care to avoiding defects that Belgian workmen are compelled to. In Belgium defects in plates are not cut out as in America, but the plates are repolished and so a shrinkage in the bracket is avoided. The Belgian plants work with three shifts daily of 8 hours each.

Mr. DeBay said that he noticed that Germany is the next most important country to Belgium shipping plate glass to the United States and that the German costs are much higher than those of Belgium and that he thought the German costs should also be considered by the Commission.

MR. RAFTER: "Will you please state briefly what effect, if any, the operation of a plate glass plant at less than full capacity has upon the cost of production?"

MR. DEBAY: "The cost price, as it is calculated by the Commission, on a capacity that is diminishing, is only affected in what we call, in the report here, plant overhead and general office overhead. For the direct labor, raw materials, power and heat and pots, you will not find any difference because those items are direct functions of the output."

Mr. DeBay, was asked by Mr. Rafter whether the prices paid for labor in Belgium are fixed by the wholesale commodity price list or index.

MR. DEBAY: "Yes sir; we have an agreement for all the factories in Belgium with a commission designated by the Government. The scale of rates follows what we call the index number. The index number is made when you compare the price of a certain number of commodities which are used by the people, and they make an average price of those commodities each month, and when that index number increases 20 points we allow a wage increase of 5 per cent. The index is published on the fifteenth of each month. The trend of the index period has been as follows: July, 1922, 366; December, 384; June, 1923, 419; December, 470; June, 1924, 492; December, 521."

MR. RAFTER: "Then the index period upon which wages were adjusted during the years 1922, 1923, 1924 and 1925 was upward from July 1, 1922, until June 30, 1924. How many adjustments or changes in wages were made by the Belgian plate glass companies?"

Mr. DeBay replied that one increase of 5 per cent was given September, 1922, and another in December. The next increase was in April, 1923, then in August, 1923, and in June, 1924. There was a decrease of 5 per cent in December, 1924, and another in May, 1925.

Commissioner Costigan asked if the movement in adjusting wages exactly followed the change in the rate of exchange.

Mr. DeBay replied that it did not, and that it is different because certain commodities come from abroad and others directly from Belgium, the latter not being affected in the same way as the others by the rate of exchange.

## Trying Out the Continuous Process

THE VICE-CHAIRMAN: "Has your plant undertaken experimentally the production of plate glass by the continuous process?

MR. DEBAY: "We are trying it out now. We began a continuous grinding and polishing machine at the end of February, this year. We are not able to use a continuous tank in Belgium because all of the factories are too small." He explained that in a continuous tank in one month enough glass could be made to take care of their full requirements for a year, and twelve months' production could not be sold.

MR. RAFTER: "Mr. DeBay, assuming that a plate glass company owns an old method plant and decides to use the continuous process and tear down the old plant and build a new one for the continuous process, in your opinion should the company charge to cost of production under the heading of obsolescence the destruction and cost of that old plant for that year in which it is torn down?"

MR. DEBAY: "No, sir. In my factory we have two mills. One was shut down 20 years ago and is not quite amortized.

MR. RAFTER: "In other words, you spread the cost of the old plant over 20 years."

Mr. DeBay stated that he would not say over 20 years because when the old factory was destroyed it was amortized. What remained at that time to be amortized was amortized by the new factory, it was added to the value of the new factory on the books and carried along as one factory value.

Vice-Chairman Dennis requested that Mr. DeBay state whether he regards American costs [as given in the Preliminary Statement] as sound, and said those costs are based obviously, in the case of the new process, on the experimental stage in the development of the industry.

Mr. Rafter objected that his clients did not admit the process as experimental at this time.

Vice-Chairman Dennis pointed out that the costs were incurred certainly when the industry was in an experimental stage and not paying its way.

CHAIRMAN MARVIN: "Is the new process fully developed, as far as you know, to enable you to determine what the saving cost per square foot the production would be?"

MR. DEBAY: "I think it is no more in the experimental stage now, because I was informed when I was in England that they were casting from it last year. Their grinding and polishing machinery was already in running operation five years ago. They began five years ago."

CHAIRMAN MARVIN: "That is only in part the continuous process, is it not?"

MR. DEDAY: "I do not know. In England it is no more the experimental process, because they did cast from the tank, and they ground and polished it by continuous machinery right from the tank. In Herzongenrath, Germany, the grinding and polishing machine has been running nearly two years. They are not casting in the continuous process, but they are casting with a new process, improving the process that we have. They are casting from pots, but on rollers, nearly the same as the continuous process."

## Semi-Automatic Process in Germany

CHAIRMAN MARVIN: "Have you any explanation as to the difference in the cost of production by the new process and the old process?"

MR. DEBAY: "Yes, I have. In fact, the continuous process for grinding and polishing in Herzongenrath will save 25 per cent of the cost of the grinding and polishing in comparison with the old system in the same factory, and the tank also saves money nearly in the same proportion. So you may be sure that the continuous process, when you go from the tank to the end of the polishing will save 35 to 40 per cent in the cost under

the old process. There is a saving of 35 to 40 per cent under the cost of the old process, if you use the tank and the continuous machinery, the two combined together."

VICE-CHAIRMAN DENNIS: "If that is true, that the costs are lowered 35 per cent by the new process in this German plant, is it not inevitable that your whole Belgian industry will swing over to the new process?"

MR. DEBAY: "But, you see, in Germany it is a small grinding and polishing machine running. We need larger machines, and it was the reason I began to try that machinery in my factory. If it is successful, the old method under the Belgian has been approved.

Cross-examining Mr. DeBay, Mr. McCumber asked if he had any definite knowledge as to what the actual savings in the Germany factory were and Mr. DeBay replied that he knew personally it was 25 per cent just at this time at that factory, where the continuous process of grinding and polishing is in operation, and not the continuous casting.

Mr. McCumber spoke of the statement made by Mr. DeBay that wages in Belgium are fixed by a commission designated by the Government. Mr. DeBay explained that the commission is composed of three members belonging to the managing directors of the factories and three men from the labor unions, and that they in accord themselves, fix the rates based on the changes in the index covering cost of living. For every increase of 20 points the wages are raised 5 per cent.

A long discussion followed regarding methods of accounting, especially in connection with charging-off for depreciation.

During another discussion on the comparative amount of breakage between glass made by the continuous process and that of the old method, Mr. DeBay explained that there is a small difference in appearance between the two types, by which the continuous process glass can be identified. The shape of the bubbles in the continuous process glass is different, being slightly elongated.

Mr. McCumber inquired whether Mr. DeBay was constructing a continuous grinding and polishing unit in his own plant and asked if it is of the same type as that used by the Ford Motor company.

Mr. DeBay replied that he has patterns in Belgium from the Pilkington plant which he is allowed to use, and a similar system is partly used in the Ford plant.

## Prices of Small Sizes

During examination of the witness regarding the production and prices of small sizes of glass, the Chairman asked whether the Union established the selling prices on the small sizes as well as the large sizes.

Mr. DeBay replied "Yes, the Union establishes the prices. That is to say, to sell in China and Japan and India, we have more competition. You see we must meet there, Pilkington, and in Japan and China we must also meet—I am not sure whether it is the American factories, but certainly some customers of the American factories, and I have seen export plates, and the price they get for the plates as shown in the report shows me that they are sending to Japan and China, and perhaps the Philippines, and Cuba. In Cuba the prices are much higher. In Mexico our prices are higher."

Answering a number of questions by the Chairman, Mr. DeBay gave information that the prices paid to the manufacturer when he sells glass to the Union is not his full return from the Union, that he still has an interest in the glass and the final prices paid to him depend upon the price received by the Union, which may vary from country to country. The final price paid to him is the sum of receipts less the Union expense of selling the glass. The manufacturer receives part of the price every month but the total price is not fully received until the end of the year, before the Union makes its balance sheet.

During the examination of Mr. DeBay request was made that H. B. Higgins, general sales manager of the Pittsburgh Plate Glass Company be permitted to question him. After a lengthy argument between counsel, permission was extended to him to do so.

## Sunk $600,000 in Experiment

Considerable discussion then followed over the definition of "cast polished plate glass" and the propriety of including costs of improvements in production costs. Mr. Higgins stated a case where his company, at their Creighton plant, had just abandoned an experiment that had cost $600,000 and stated "The only benefit we have had from that experiment is to find out that the ideas which we held a year and a half or two years ago were wrong. Would that sort of an experiment, in your opinion, be a proper charge against obsolescence, or should that expense be capitalized? It has been abandoned. It is given up. It is an expense."

## The Bicheroux Process

Later on the examination led to a question by Mr. Higgins as to whether the continuous tank process is not the most modern method of making glass. He asked whether there is "not still another method of making rough glass by continuous grinding and polishing, a method of modified casting which today is being rather generally adopted in the best factories."

Mr. DeBay replied that he thinks the continuous process is the most modern and the Bicheroux process follows, because it is only suitable to small factories.

MR. HIGGINS: "Has not the Bicheroux process the advantage of producing large sizes as well as small sizes, and is not the great disadvantage of the tank method of production its inability to produce the large sizes?"

MR. DEBAY: "The Bicheroux process, as far as I know, and I have only seen casting with the Bicheroux process in Herzongenrath, they are not doing large plates; only small plates; plates suitable only for the grinding and polishing by the continuous process."

MR. HIGGINS: "You are familiar with the fact that manufacturers today, and the best of them in this country and abroad, are considering the adoption of the Bicheroux method, are they not?"

MR. DEBAY: "They are considering it. In fact, you have only one factory in Belgium considering that process, and until now, not a large plate has been cast with the Bicheroux process in the same dimensions as with the other process."

MR. HIGGINS: "You know that two of the largest manufacturers in this country are now considering the adoption of that method?"

MR. DEBAY: "I know the Edward Ford Plate Glass Company has all the patents."

It developed that the Standard Plate Glass Company has also had the use of the Bicheroux process under contemplation.

Mr. Higgins asked the maximum size of plates being considered in the new Bicheroux installation abroad and Mr. DeBay stated that he had seen at Herzongenrath only machines producing "two plates of two meters width" and that the largest sheet contemplated is "one meter fifteen, two flowing from the rollers together."

On re-direct examination Mr. Higgins asked Mr. DeBay whether he considered the Ford process at River Rouge fully developed and a success in every respect.

MR. DEBAY: "I think it is a success, because they put that process in action in Pilkington. Pilkington also bought the process of the Bicheroux. I know that the Pilkingtons were in Herzongenrath six weeks ago."

## Control of Belgian Production and Prices

During cross-examination, Commissioner Marvin, referring to the Belgian Union, asked whether it would be possible, under the organization of the Union, to direct that there be production of the sizes of glass most economically produced by the continuous process by certain individual plants, members of the combination or Union, permitting the remaining plants to make the larger sizes of glass. Mr. DeBay replied that it might be.

VICE-CHAIRMAN DENNIS: "I am going to ask you a blunt question. Do you consider this Union Commerciale des Glaceries Belges a cartel organization that has power to establish the amount of national production, fix prices both for the domestic and foreign purchaser?"

MR. DEBAY: "The Union Commerciale fixes only the price for what we call foreign markets, but the Union has nothing to say about the output of the factories."

VICE-CHAIRMAN DENNIS: "Conversely, is it not perfectly possible to establish a foreign price that is below the level of the domestic market and so capture any foreign market you please, provided your domestic sales warrant it?"

MR. DEBAY: "Our domestic market is very, very small. You see in Belgium we use at the maximum 5 per cent of the output of the factories; 95 per cent is exported."

VICE-CHAIRMAN DENNIS: "I was thinking of the exportations to America. What per cent are your exportations to this country?" MR. DEBAY: "I think 25 per cent of the output."

VICE-CHAIRMAN DENNIS: "The point is this, could you not sell that 25 per cent below the cost of production and recoup your losses by the sale at higher prices, through the control exercised by your cartel?" MR. DEBAY: "No. We sell too much in the States to make such a cut inprices."

COMMISSIONER COSTIGAN: "You testified earlier this afternoon that you have not made it a practice to sell in the United States at lower prices than you sell for in Belgium." MR. DEBAY: "No, sir."

COMMISSIONER COSTIGAN: "Have you never sold below the Belgian prices, in the United States?" MR. DEBAY: "I do not think so, but if you like I might ask the Union to send to the Commission all the prices we have made."

### S. C. Gilmore a Witness

After the cross-examination of Mr. DeBay was concluded, several witnesses representing the interests opposed to the applicants in the case were called, the first one being Samuel C. Gilmore of Philadelphia, a jobber of flat glass, with warehouses in several cities.

Mr. Gilmore submitted a computation sheet showing that stock sheets of glazing quality plate glass are being imported by his concern this year, and have been for several years past, at prices from 5 to 7½ per cent less than they would have to pay for American glass of the same quality, in sizes exceeding 5 square feet, landed in their warehouses. The 25 to 50 foot bracket, large sizes for store fronts, in American glass cost 51 cents delivered in Philadelphia. The foreign glass costs 47½ cents. The bracket which the American manufacturer pays 51 cents for is sold by importers who sell from the docks, or warehouses near the docks, without putting their glass into stock, at as low as 50 cents or even 48 cents. In order to compete with these importers those selling domestic glass must also sell imported glass at similar prices. This is less than the dealer pays the American manufacturer for the American glass he carries in stock.

Customers, according to Mr. Gilmore, who formerly came to him for American glass are now buying plate glass from the importers at the price he has to pay the American manufacturer. In self-defense, Mr. Gilmore said, his concern had been obliged to buy foreign glass. Mr. Gilmore had previously testified that he had an investment in the Standard Plate Glass Company and gave that as a reason why he continued to purchase domestic glass, when it is more profitable to handle imported glass.

Mr. Gilmore testified in answer to a question that the breakage allowance given by the foreign manufacturers more than covered, in his experience, the breakage which he had encountered, and that most of his importations were larger than 5 square feet in area. He gave the information that purchases were made from the Union Commercial and from the Saint Gobain company through their New York agents. He stated that 20 per cent of his company's total supplies were imported and the remainder purchased in the American market.

Vice-Chairman Dennis inquired why, if they could buy from 5 to 7½ per cent cheaper from the foreign producers, their imports did not exceed 20 per cent of their needs, and was informed that an important factor in importing goods was the necessity sometimes for waiting for deliveries.

Commissioner Costigan asked if he knew of any other reason why there should be the continuing price differences between domestic and imported glass, than the one of difference in the cost of production, and Mr. Gilmore replied that foreign manufacturers' agents had informed him that in order to overcome the difficulties in shipping glass to this country by reason of the delay, they must give the importer the inducement of a somewhat lower price.

CHAIRMAN MARVIN: "If you carried a stock of imported glass and a stock of domestic glass in your warehouse there would be no advantage or disadvantage to the foreign manufacturer or to the domestic manufacturer in the distribution of glass by your concern, would there?"

MR. GILMORE: "There would not be if all of our competitors carried the imported glass in stock, open, in racks, ready to distribute. But, as I have already explained, some of the importers ship the plate glass in the original cases right off the docks and take the advantage of this difference in the price of 5 to 7½ per cent, selling it to consumers at practically what we pay for the American glass. They seem to be satisfied with from 5 to 7½ per cent profit on a transaction of that character. Sometimes they will sell glass before it arrives, and ship it as it comes in from the dock." Mr. Gilmore stated this meant that such importers did not have the expense of operating a warehouse.

MR. WILSON: "How can you afford to sell carload lots of glass at American factory prices if you do not get some shade off the price to the jobbers from the factory?"

MR. GILMORE: "I explained that in selling the imported glass at the American manufacturer's price, we sold it in the original cases as they arrived at the dock, and generally deliver and ship from the dock, without bringing it into the warehouse and encumbering the overhead expense attendant upon a general jobbing business. In selling American glass we must add a profit on what we pay for the American glass. We rarely sell American plate glass in the original cases, because we cannot compete with the importing broker. That is opened up and put into our stock and used for cutting and delivering to the buildings."

Many other questions regarding the importation of plate glass were asked of Mr. Gilmore, but little in addition to those facts brought out by previous witnesses was developed.

### Southern Jobber Testifies

Powers Pace of F. J. Coolidge and Son, flat glass jobbers and paint manufacturers, operating three warehouses, at Atlanta and Savannah, Ga., and Sanford, Fla., was the next witness called.

He testified that his company made one importation of plate glass in 1923 but no additional importations because the deliveries to ports in their section of the country by steamers from Belgium is irregular and could not be depended upon for a regular source of supply. His testimony regarding the purchase and handling of plate glass imported into this country was along the same lines as that of Mr. Gilmore.

Asked by Mr. McKenna whether his business was adversely affected in any way by the distribution of foreign glass, he replied that in Florida, particularly, the distribution of case lots has seriously curtailed their business. Anticipating a large business in Florida they invested considerable money in warehouses and distribution facilities. Their expectations were not realized due to the fact that, where formerly they had two or three competitors, they now have fifteen or twenty-five in the same territory. Mr. Pace said the fact he wanted to bring out was that his firm had a satisfactory business in the state of Florida and that "other jobbers who maintained warehouses and bought carloads of glass were our principal competitors; that a great many small glaziers who had no financial responsibility, no warehouse and no capital, had been able to purchase single case lots of stock sheets of plate glass with which they competed with us on glazing contracts at prices much lower than we could sell."

Asked whether the Pittsburgh Plate Glass Company maintained warehouses in Georgia and Florida, competing with him, Mr. Pace answered affirmatively. Mr. McKenna inquired if he knew whether or not the Pittsburgh Plate Glass Company charged its warehouses the same prices that they charge other dealers or other owners of similar warehouses, Mr. Pace stated that he could only testify to what he had heard in that connection. Mr. Pace also said that the competition he would feel would be competition of the Pittsburgh warehouses, rather than the manufacturing concern, as there is a Pittsburgh company as a manufacturer and a Pittsburgh company as a jobber. Asked by Mr. Wilson if, when he put in a sealed bid under specifications for a large contract, for instance, in Miami, whether the two Pittsburgh warehouses would also put in bids, Mr. Pace stated that in all probability they would.

### W. J. Schoonover

The next witness was W. J. Schoonover. Mr. Schoonover is a distributor of flat glass with warehouses at Scranton, Wilkes-Barre, Allentown and Utica. He is the immediate past president of the National Glass Distributors Association.

He stated that the members of the association are distributors of foreign as well as domestic glass, but that he was appearing in his individual capacity rather than as a member.

Answering Mr. McKenna, who inquired whether distributors of domestic polished plate glass were jeopardized by the importation of foreign plate glass, Mr. Schoonover stated that they were, very seriously. They lose in footage volume because of the com-

petition occasioned by the lower price of foreign plate glass and practically all profit has diminished or disappeared from the distributor. He said that is true in his own business and believes that it is quite general. It is only in very favored locations that a distributor is able to make money. Those who have been buying the imported glass have an advantage in price which they pass on to the consumer, and it is an advantage over the man who buys the American product at the higher price. It has injuriously affected his own business because some of his customers have been able to buy single cases of plate glass at prices as low as or lower than the American factory price to him in carload lots.

Questioned as to the sizes of glass referred to, Mr. Schoonover stated that he was interested largely in sizes over 5 square feet.

Replying to Mr. Wilson, as to whether he found that in bidding he was in competition with manufacturers of plate glass, Mr. Schoonover said if Mr. Wilson was referring to the Pittsburgh Plate Glass Company, that when quoting on shipments direct from their factory he would consider that they had the advantage, but that when the glass comes out of the local warehouse they did not have any advantage. He testified that he got a good big percentage of the glass jobs he figured on in competition with the Pittsburgh Plate Glass Company.

Asked by Mr. Rafter if these jobs related to glass over 5 feet square in size, he replied affirmatively and that it related to glazing quality.

COMMISSIONER DIXON: "Your chief objection to the importation is that it injuriously affects your business as a distributor?"

MR. SCHOONOVER: "Yes, sir, and the country in general."

COMMISSIONER DIXON: "Would you take the other side of the proposition and say that the manufacturers of this country, or the farmers of this country should not be allowed to export their goods if men engaged in industries over there felt it injuriously affected them?" MR. SCHOONOVER: "I am not familiar with that question enough to be able to answer it."

The Vice-Chairman asked if imports were cut off would prices rise, and Mr. Schoonover replied that they would.

THE VICE-CHAIRMAN: "How would that affect the consumer —advantageously or otherwise?"

MR. SCHOONOVER: "If the importation of plate glass keeps on increasing as it has been in the past few years many American workmen will be thrown out of employment, and those who have money invested as glass distributors will lose due to the competition of foreign glass at reduced prices."

THE VICE-CHAIRMAN: "There is another angle, too, is there not, that if imports were cut off probably there would be an increase in the production in this country and the competition would be just as keen and the prices, after all, would not be higher than they are now? And the ranks of the consumers in the long run are pretty well automatically protected by the fact that whenever there is great profit in any industry, other industries spring up and the competition is just as intense as if we had the element of foreign imports?"

COMMISSIONER COSTIGAN: "Do you think there is room for independent producers of plate glass on a large scale or on a small scale in the United States at this time?" MR. SCHOONOVERS "I believe that factories properly financed would be able under similar circumstances to compete with the present manufacturers."

## Richard B. Tucker

Richard B. Tucker, president and general sales manager of the Standard Plate Glass Company was the final witness.

Mr. McKenna called attention to the fact that anything Mr. Tucker testified to would be subscribed to by the National Plate Glass Company, Edward Ford Plate Glass Company, Standard Plate Glass Company and the American Plate Glass Company.

Mr. Tucker was questioned at length as to the point which should be chosen as a basis for comparison between the costs of production of domestic and foreign plate glass, and as to foreign plate glass selling methods, also as to the period which should be covered in determining comparative costs. Landing charges also were discussed. Several of these subjects were gone over at great length.

The question as to whether selling expenses should be included in production costs was also brought up. Mr. Tucker's opinion was that only factory selling expense should be included and only selling expense involved until the time the title of the glass passes from the hands of the producer.

In connection with the landing charges, Mr. Tucker submitted a list of the principal distributors of glass in New York City which showed that of the twenty leading concerns, seven have side tracks connecting with their warehouses, and thirteen have no sidings.

MR. TUCKER: "If the Longshoremen's Union in New York do compel every company receiving imported glass to have that glass loaded from the dock to their trucks by the Union, making a charge of four or five dollars per case, depending upon the size of the case, I claim that that relieves that particular company who has to send to the dock for their glass, of responsibility to send with their truck more than the chauffeur who is driving the truck. He has to send no extra labor with the truck to haul the glass away, whereas in the case of the distributor of glass in New York who is either receiving his glass on cars and hauling it from the side-track or receiving it through the local freight warehouse, he is compelled to send four or five additional laborers with the chauffeur to load that glass from the car or from the warehouse to the truck. The cases weigh from 2,500 to 3,500 pounds, so that the cost of the labor involved in loading the domestic glass from the cars to the trucks is equivalent to the cost of having the Longshoremen's Union lift the cases of imported glass from the dock to the truck."

## Reverts to the Continuous Process

Mr. McKenna referred to question No. 6 in the Commission's preliminary statement: "Has the development of the continuous process reached the stage where its cost of production may be deemed normal or representative?" and stated that Mr. Tucker's testimony on this point would relate solely to the Standard Plate Glass Company.

Mr. Tucker said: "The Standard Plate Glass Company has had before it the ever-increasing difficulty of keeping its costs as low as possible and naturally has investigated, as any other company has done, I presume, ways and means of accomplishing that end. Through our engineering forces we have made a very comprehensive and thorough study of the continuous process of manufacturing polished plate glass, and the conclusion reached by our engineering staff is that when viewed from the viewpoint of manufacturing glass for general commercial purposes that the continuous process is impracticable, and we have decided not to make further investigation because we cannot see any economy, from our viewpoint, that can be accomplished through the adoption of the continuous process."

COMMISSIONER COSTIGAN: "Does it represent a complete return to the old method of making glass or do you expect to see some combination of the two methods, or modifications?"

MR. TUCKER: "I may have to resort to saying that some information involved in that is of a very confidential nature. But I will say that our investigations have led us to believe that there are processes being used in Europe which would give us a much more desirable method than the adoption of the continuous process would."

MR. MCKENNA: "Mr. Tucker, did you hear the testimony of Mr. Solomon to the effect that the duty could be reduced 50 per cent without resulting in increased importations of glass? What are your views on that matter?"

## Probable Effect of a 50% Tariff Reduction

MR. TUCKER: "My views are that so far as I know every American manufacturer has a tremendous surplus on the small sizes, as to the sizes involved, and any greater influx of those sizes would make a bad situation exceedingly worse and most inevitably reduce the realization on those small sizes which are already away below the cost of production because of the very keen competition among the American factories in their anxiety and desire to dispose of the glass of which they have a tremendous surplus and of which they must inevitably continue to have a surplus.

Mr. McKenna inquired whether jobbing conditions had undergone a change because of importation of foreign glass and was assured by Mr. Tucker that such was the case.

MR. TUCKER: "I will use as typical of the changed jobbing conditions the warehouse operated by the Standard Plate Glass Company in Boston. That warehouse has been established as a jobbing concern in Boston for more than 23 years, and I think it enjoys the reputation of being an exceedingly representative establishment for the distribution of glass. Our primary business in the

distribution of plate glass was to sell cases of domestic glass to the dealers in and around Boston territory. At the same time we also did a certain amount of contract glazing work, but the bulk of the glass disposed of through Boston was in cases to the dealers in the greater Boston territory.

"Since 1923 we have gradually lost entirely this business of selling cases to the small dealers in and around Boston, and our warehouse finds the cause of that is that cases of imported glass are being sold to this class of trade at and below the cost of delivering cases of domestic glass in Boston in carload lots, unloading into the warehouse and then distributing from that point. So the business of our warehouse has been very vitally affected, and we have to confine our energies almost entirely, because of the distribution of the products manufactured by the foreign companies, to the contract glazing or building operation."

Mr. Tucker offered for filing a certified copy of the statement of the Standard Plate Glass Company for 1926 and a certified copy of the statement for the first quarter of 1927. Mr. Tucker stated that it covered the manufacture of polished plate glass, manufacture of paint and operation of jobbing warehouses.

## Diversified Products Increase Competitive Resistance

Mr. Wilson asked Mr. Tucker if he did not think that his company, by reason of its manufacture of paints and varnishes, is not in a better position for competitive resistance than a company dealing in and manufacturing only plate glass. Mr. Tucker admitted that it would.

Mr. Wilson asked that the restriction put upon the use of the report of the Pittsburgh Plate Glass Company (Exhibit 57) be enlarged to cover the exhibit as a whole and not restricted exclusively to the cost of production and other references to polished plate glass.

MR. KOPLIN: Mr. Chairman and Gentlemen of the Commission, it is the position of those on this side of the table that the competitive resistance, the ability of the Pittsburgh Plate Glass Company and the other companies to resist the competition of the Belgian plate glass manufacturers on account that they might be engaged in the business of making paints and varnishes, has no more relevancy or place in this hearing than the fact that they might have been engaged in the business of private bankers or something else as an independent enterprise. As I understand it, this inquiry is supposed to be directed to the ascertainment of the costs of production of plate glass. Now, how can the results of the operations of a company in the paint business or brush business or any other kind of business have anything to do with the costs of producing plate glass, when this Commission has sent out its own experts and ascertained that cost, and there is no attack on the part of these producers as to the accuracy of the costs so found.

"I certainly submit that it is entirely irrelevant and immaterial and has no place at all in these proceedings—what the results of the operation of the Pittsburgh Plate Glass Company, the Standard Plate Glass Company, the American Plate Glass Company or any other plate glass company might have been in some other line of business entirely apart and separate from the plate glass business."

THE VICE-CHAIRMAN: "Are we dealing with a national industry rather than a particular industry? Suppose this particular industry had water rights to sell, as some industries do. Would you count that an offset with respect to losses in the manufacture of plate glass when you speak of competitive resistance."

MR. WILSON: "I would consider if the use of that water power by an industry in this country has the effect of lowering its cost of production, because of there being no water power privileges or rights in the foreign country, that it was an element to be considered."

The Chairman inquired as to what advantage in competition there is between a domestic manufacturer of plate glass and a foreign manufacturer of plate glass because the domestic manufacturer is engaged in some other line of business besides the production of plate glass.

Mr. Rafter replied that at a time when the plate glass industry is not prospering in this country, a company in the position of the Pittsburgh Plate Glass Company would be able to survive and perhaps do very nicely because of the business done in their other products.

THE CHAIRMAN: "Well, I cannot see, Mr. Rafter, how it affects the comparison of costs of production of a like or similar article."

MR. MCCUMBER: "Mr Chairman, one of the strongest competitors of plate glass in the United States, as I understand it, is St. Gobain, a manufacturer in Belgium who is also engaged in the manufacture of chemicals and the distribution throughout Europe, and undoubtedly makes considerable in the chemical business; and I certainly would not ask the Commission to adjourn this hearing until they could find out what profit was being made by this company in its chemicals. Neither would I ask the Commission to take into consideration any loss that the Pittsburgh Plate Glass Company might have had any time in its brush and paint business. And I do not think if we attempted to produce that as against them on the other side that they would consent that we should introduce it."

## Last Session of the Hearing

At the last session of the hearing on Friday, May 13, Richard B. Tucker of the Standard Plate Glass Company resumed the witness stand and a long discussion ensued as to his views on the various problems propounded by the Tariff Commission on pages 2, 3 and 4 of the second preliminary statement of information.

The question of determining what period should be taken for cost comparisons and the identity in price between the different American companies and the origin of that practice was taken up and discussed.

Chairman Costigan inquired regarding the association known as Plate Glass Manufacturers of America and it was brought out that all of the American plate glass producers are members, except the Ford Motor Company and the Libbey-Owens Sheet Glass Company.

Mr. Tucker pointed out that the association absolutely does not follow the practice of exchanging information in advance of issuance of new price lists, but that its purpose is to gather statistics and data, a copy of which is sent to the Department of Commerce for government records. Another object is to advertise polished plate glass and increase the consumption of it.

In answer to a question by Mr. Rafter as to whether Detroit compared with other cities, showed a larger percentage of purchases of plate glass, Mr. Tucker replied: "I said that I assumed that, Mr. Rafter, but I did not know. Now, I find that since that question has come up for discussion that I may have given a wrong impression in that direction, because the tendency of the automobile companies has been to spread out their body plants. For instance, take the Chevrolet, which is producing more automobiles than any other model in this country at the time being. You think of the Chevrolet car being manufactured by the General Motors Company in Detroit. As a matter of fact, the Chevrolets are built at St. Louis, Norwalk, Ohio, Syracuse, N. Y., and Pontiac, Mich. And I don't know that any of them are built at Detroit."

MR. MCKENNA: "And Oakland, Cal.?"

MR. TUCKER: "Yes, and Tarrytown, N. Y. So I may have given quite a wrong impression in thinking of Detroit in terms of the automobile. It is the general office of a great many companies, but when we go to the body plants that consume the glass, they are scattered all over the country. Take the Ford Motor Company with its distributing warehouses. The Ford Motor Company ships its bodies to be assembled at those various assembling points scattered up and down the Atlantic seaboard, the Gulf seaboard and on the Pacific Coast, and through some of the other principal cities. So the glass consumed in the automobile business has been spread over the entire country, and although we think of Detroit as the center of the automobile industry, it is the center of the general offices but not of the body building plants."

## More About the Bicheroux Process

When answering a question by Mr. Rafter as to whether in his opinion glass produced by the continuous process was not a practical proposition for general commercial purposes, Mr. Tucker stated that the Edward Ford Plate Glass Company at Rossford, O., have had access to the plants of the Ford Motor Company and made a very thorough investigation, but through Mr. Husted of that company, he had learned, it has not been convinced that it is practicable to manufacture plate glass for general commercial purposes by that method, and as a result of their investigation of the plants of the Ford Motor Company at River Rouge and Highland Park they had decided that they must look further for the ideal process for manufacturing plate glass, and they have made a contract through the St. Gobain Company. "I do not know whether they are the holders of the patents or not—for the Bich-

eroux patents, and their drawings have all been prepared for the installation, and their engineers are making a trip this year to see the operation of the Bicheroux patent. That was reached after the conclusion that they could manufacture their rough plate more economically by the Bicheroux patent than they could by the installation of the continuous process patent.

"Speaking of the Standard Plate Glass Company, we have had up with the St. Gobain Company the same question, because, as I testified yesterday, our corps of engineers have made a thorough investigation into the continuous process of manufacturing glass, and we found that it was impractical and not economical for a plant manufacturing plate glass for sale for general commercial purposes. Last fall Mr. Taylor, managing director of plants of the Pilkington company, called on me with reference to the sale to the Standard Plate Glass Company under royalities of a patent which they own in connection with grinding and polishing. I asked him at that time if he had installed the continuous process. He said that they had; that they had it installed and had in operation the Ford process of drawing from the continuous tank. I asked his opinion of the success of that, and he said, 'We are thoroughly convinced that it is not an economical and practical method of making rough plate glass which later to grind and polish for general commercial purpose, and we were investigating the Bicheroux patent with a view of abandoning the tank operation in our plants in England, and substituting in its stead the Bicheroux patent,' which conclusion you may see had a very strong effect on the officers of the Standard Plate Glass Company, in the conclusions that they had reached not to investigate further the continuous process, after our conversations with those two groups of foreign manufacturers. So that we feel, and we feel very convinced in our organization, that the systems abroad have gone much farther in reducing the cost on the general average in the adoption of the Bicheroux patent and the possibilities of reducing the cost are much greater than they are through the continuous process that has been adopted in the United States. I think I might go farther than that and say that any attempt to manufacture glass in wide sheets from the continuous process has been abandoned by all the plants of this country."

CHAIRMAN MARVIN: "What is the widest sheet that is being being made?"

MR. TUCKER: "The widest sheet that is being made is 72 inches, at the time being, and any attempt to manufacture glass wider than that has been entirely abandoned."

### Sequence of Ford Motor Plant Construction

MR. RAFTER: "How long after the Highland Park plant was in operation was the second Ford Motor Company plant at River Rouge started; do you know that?" MR. TUCKER: "No, I do not."

MR. RAFTER: "Do you know how long that River Rouge plant was in operation and producing glass when the Ford Motor Company began construction of the St. Paul plant?"

MR. TUCKER: "I understand they did not construct the plant at St. Paul; that they built that building for another purpose, and then after they decided not to use it for that purpose, they decided to put the glass plant there."

MR. RAFTER: "And the third plant installation was made some long time after the second plant was producing?" MR. TUCKER: "Yes."

MR. RAFTER: "Is not that same situation true with respect to the two units of the Pittsburgh continuous plant at Creighton?"

MR. TUCKER: "I have never been there, so I do not know."

MR. RAFTER: "I mean regarding the time in which the two units were built."

MR. TUCKER: "I think so. I understand the Pittsburgh Plate Glass Company was terribly sorry that they ever started on that second unit; that they have not made any glass in there. They wish they had not started it."

MR. RAFTER: "Would you be surprised to hear that an official of the Ford Motor Company said it was perfect nonsense to refer to the continuous process as experimental?"

MR. TUCKER: "No, I would not be surprised to hear that at all, sir. However, that does not change my verdict and the version of the engineers of the Standard Plate Glass Company that it is not only experimental but still in a very, very experimental stage."

### Domestic Price Reductions Due to Imports

VICE-CHAIRMAN DENNIS: "Two or three years ago, it seems almost like a month now, I asked some witness whether he believed that the imports established the domestic price, the current price of plate glass, and he was rather in doubt about it. You made a remark a little while ago which seemed to confirm the fact. You stated that the Pittsburgh Plate Glass Company in their reductions established the price, but that their reductions were occasioned by foreign competition."

MR. TUCKER: "I am absolutely convinced of that, Mr. Commissioner."

VICE-CHAIRMAN DENNIS: "Now suppose there were no importations whatsoever; suppose the duty was raised so high that the Belgians were shut out entirely, practically embargoed, do you think it would be impossible to establish a domestic price, within the anti-trust law, through some sort of a community of interest—it might be a tacit agreement; you might not even have a definite agreement—that would assure each plant of having a decent living, I mean, taking the analogy of steel: The United States Steel Company is said to hold an umbrella, as it were, over the heads of their less fortunately placed domestic competitors. They all manage to get along in the steel business, and the marginal producers have a show, and the less advantageously situated mills in respect to the fuel and the ore all manage to get along, do you think a condition of that sort would prevail in the American plate glass industry?"

MR. TUCKER: "Indeed I do. I think it perfectly practical."

VICE-CHAIRMAN DENNIS: "You do not think that would lead to a stimulation of the domestic industry and eventual overproduction such as we are having in so many other large industries at present?"

MR. TUCKER: "No, I don't think so. Speaking now from my own experience, we have had a pretty severe lesson in overproduction, and what an over-supply of plate glass can do for you."

COMMISSIONER COSTIGAN: "If that result followed, would the consumer have any means by which he might protect himself?"

MR. TUCKER: "I think that there is sufficient protection and sufficient active competition, Mr. Commissioner, to allow the consumer to be properly taken care of, and I think at the same time preserve the investment in an important American industry. In other words, I think the rule of common sense would apply.

### Regarding Desired Tariff Changes

MR. MCKENNA: "Mr. Tucker, have you a statement to make concerning the inquiry of Mr. Commissioner Costigan?" MR. TUCKER: "Yes, I have. Since yesterday's adjournment I have given consideration to the question raised by Commissioner Costigan relating to the changes desired in the tariff on polished plate glass by the American producers.

"The determination of this question involves not only a careful consideration of the entire record of the hearings before the Commission and the two preliminary statements made by the Commission, but will necessitate detailed calculations as to the results to be obtained by the final recommendations which I have been unable to make. In this question is also involved a most careful study of the effect of the change to be proposed on the industry as a whole, and in the various schedules in the tariff on related items.

"No definite conclusion could be reached by the companies for whom I speak, until the record is completed. I think it is only fair to the Commission and all concerned that any suggestions made should represent the mutual views of all concerned. The brief which will be filed on behalf of the companies for whom I speak will contain a detailed answer to the question, and a complete analysis of the results expected under the changes to be suggested."

MR. MCCUMBER: (representing Pittsburgh Plate Glass Company)—"We wish to say on behalf of this company that we think you have made a wonderfully splendid exposé of all the matters that are important, relating to this glass industry and importations, and have presented it so comprehensively and so thoroughly, bringing out every possible question in which the trade might be interested, that we could not add to it, we believe, by any testimony that we can give and for that reason we will not introduce any further testimony only to say that if the Commission or any member desires to call upon the representatives of this glass company for any information bearing upon this subject, they are here to answer your request. Otherwise we will not present any further testimony on their behalf, believing that it has been well covered."

# Glass Industry

ESTABLISHED 1920

The First Trade Journal Devoted Primarily to Glass Technology, Engineering, Raw Materials, and Glass Factory Equipment and Operation

Published Monthly


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GLASS INDUSTRY PUBLISHING COMPANY, INC.
50 Church Street, New York

Telephones { Cortlandt 2465 / Cortlandt 5618 — Cable Address, Glasdustry

J. B. KRAK, Technical Editor

Subscription Price.....$2.00 a Year
Single Copy.....20 Cents

THE GLASS INDUSTRY circulates extensively among American and foreign glass manufacturers, their business executives and technical and factory operating staffs.

CONTRIBUTIONS

THE EDITOR welcomes practical articles on all subjects related to GLASS MANUFACTURING. Such articles, if accepted, will be paid for at our usual rates.

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## Selecting the Best Process

The hearing on plate glass production costs, held by the Tariff Commission at Washington, and reported in detail in this and in the preceding issue, disclosed some extremely interesting information with regard to the relative efficiency of various processes of making plate glass, in use at the present time. A perusal of the testimony clearly brings out the dependence of the different glass-producing countries on each other relative to improvements of glass-forming methods.

In this country the Ford Motor Company process of making windshield glass by a continuous method is obviously successful. The process has been installed at the plant of Pilkington Bros., Ltd., in England. Testimony obtained at the Tariff investigation disclosed the fact that perhaps a million feet of glass from the Pilkington plant has been purchased by the Ford Motor Company. It is quite evident then that the Ford continuous plate glass process is a success in England as well as on this side of the ocean.

In view of this knowledge, it is startling to learn that the Pilkington Company has considered abandoning the Ford process which uses tanks for glass melting purposes, and introducing the Bicheroux methods of using pots and casting the molten glass directly in front of a revolving roller. A short description of the Bicheroux process, which in use at Herzogenrath, Germany, appears elsewhere in this issue.

Of great significance is the statement, made by Richard B. Tucker, president of the Standard Plate Glass Company, at the Tariff investigation: "We have made a thorough investigation into the continuous process of manufacturing plate glass and we find that it is not practical and not economical for a plant manufacturing plate glass for general commercial purposes. We feel convinced that the Bicheroux process has gone much further in reducing the cost than has the continuous process adopted in the United States." Quoting Mr. Tucker again: "I may say that any attempt to manufacture glass in wide sheets from the continuous process has been abandoned by all American plants."

Engineers of the Edward Ford Plate Glass Company have also come to the conclusion that they can manufacture their rough plate glass more economically by the Bicheroux process than by the continuous system such as has been developed by the Ford Motor Company.

The names of glass-forming processes known as Owens, O'Neill, Miller, Westlake, Libbey-Owens and others are as familiar in European countries as they are here. However, we have no monopoly of inventive genius, when it comes to glass-making machinery. While this country has produced Colburn, Belgium claims Fourcault as her own. The Libbey-Owens system of producing window glass is growing side by side with the Fourcault process, both here and abroad.

It is the part of wisdom to recognize that the glass industry is world-wide, that all the great glass producing countries should be and are co-operating to develop the most efficient machinery for each individual purpose and that each country should be and is willing to abandon its own processes, as soon as it is proved that those of other countries are more economical to operate.

This spirit of international co-operation is advancing the best interests of the glass industry the world over.

# Activities of the Society of Glass Technology

Meetings of the Society of Glass Technology were held in London, on May 18 and on May 19, 1927, the President, Mr. W. Butterworth, Senior, M.A., in the chair.

At the meeting on the afternoon of May 18, the following three papers were presented:

THE DECOMPOSITION OF GLASS BY WATER AT HIGH TEMPERATURES AND PRESSURES.—By Dr. G. W. Morey and Dr. N. L. Bowen.

The glasses were heated with water in steel bombs for about 20 hours. The bomb was then cooled and the product examined. In the case of optical glasses it was found that the barium glasses presented a consistent picture. The amount of attack was greatest with a light barium crown, and least with the very dense barium crowns which were remarkably resistant. The lead glasses, as a whole, showed a consistent and interesting relation between composition and resistivity. With small PbO content, as in the "soft crowns" or extra light flints, the glasses were badly decomposed at 300° C and practically complete at 550°. As the lead content was increased, the glasses rapidly improved, the extra dense flints showing remarkable resistance towards water. Of all the glasses tested, a high lead glass was the most resistant to the action of water under the extreme conditions tested.

In addition to the optical glasses, a number of commercial glasses, in the form of pieces of tubing, were subjected to a similar treatment, at the same temperatures. Jena combustion tubing withstood the action of water best, whilst the failure of Pyrex glass was outstanding. At lower temperatures the Pyrex was exceedingly good, but at the higher temperatures of the experiments the boric oxide was completely extracted. The crystals obtained with Pyrex glass at 325° were unknown but were of particular interest, and their composition was being studied.

THE BRITTLENESS OF OPAL GLASS.—By Prof. Dr. G. Gehlhoff and Dr. M. Thomas.

For the determination of the impact strength a special apparatus was described; and Winkelmann & Schott's method was modified by using pressed balls instead of ground and polished cubes. A dense opal glass containing much fluoride was used, the opacity being increased by the addition of zinc oxide. It was found that at a temperature of about 1040° C some discontinuous changes took place, possibly explainable in the following way. At high temperatures the opal glass was clear. In cooling down, crystals of a uniform and small size of grain were precipitated. The glass kept below the devitrification temperature already contained (owing to its having stood longer) bigger crystals. On further cooling down in conformity with the law of the yet undefined constitution diagram, small crystals were precipitated, whereas the existing big ones still grew. It might appear feasible that the opal glass, containing only crystals of a uniform and small size, possessed greater mechanical strength than a glass consisting of crystals of various sizes, particularly larger ones. The investigation showed that opal glasses must necessarily be worked above the temperature where precipitation of crystals caused opacity of the glass: brittleness resulted if they were worked below that temperature. It was suspected (from work being done) that similar phenomena held good in respect of clear glass.

THE NEW BRITISH 15-ARM AUTOMATIC SUCTION BOTTLE MACHINE. By Francis Redfern. Jr.

This machine is composed of 15 separate bottle-making units, each complete in itself. All the important bearings on the machine are Timken roller bearings or ball bearings, totally enclosed and dirt proof. There are approximately 40 tons of moving parts mounted on the stationary element and the whole machine weighs about 60 tons. It will revolve up to speeds of between 6 and 7 revolutions a minute, and is electrically controlled. By means of an electro-magnetic brake automatically applied it can be brought to rest from a speed of 6 revolutions a minute within 2½ feet. To accommodate the machine to the level of the pot, or the glass in it, it is raised or lowered by a small motor which is cut out automatically at the highest and lowest positions. At 6 revolutions a minute, the machine takes about 11½ horsepower to revolve it. The machine is constructed in such a way that it is possible to sit inside it while it works. The range in length of bottles (measured from the bottom to the parting line below the ring) which can be manufactured on the machine is from 15 inches to 2½ inches, for a maximum diameter of blow mold of 9 inches and of parison molds of 7 inches. Wide mouth ware can be made in which the maximum outside diameter of the neck mold is 5¼ inches, and the maximum length of plunger which can be inserted into the bottle is 2⅞ inches. A week's production of merchantable reputed quart bottles is estimated at 2,800 gross.

The machine can be produced in three sizes—6 units, 10 units and 15 units. For bottle makers whose trade is of a miscellaneous character, it is claimed that a machine of this design would be ideal. It was possibile to make on it, at one and the same time, six different bottles all of different shapes, varying in height within a difference of 3½ inches. Bottles varying in weight by 4 ounces have been made on a 10-arm machine.

The meeting on the afternoon of May 19 was devoted to a discussion of Furnace Efficiency. The discussion was opened by Prof. W. E. S. Turner, who gave a resume of the paper he had presented at the April meeting, namely, "A Brief Review of Furnace Developments."

Mr. B. P. Dudding and Mr. E. A. Coad-Pryor suggested that the discussion be focussed under the following headings: (a) Load-Fuel Consumption; (b) Age of tank; (c) Load and Effect on total life; (d) Maximum Efficient load; (e) Composition of the glass; (f) External conditions of all kinds such as contour of neighboring county, prevailing wind, etc.; (g) General design—ports, bridges, melting areas, etc. At the suggestion of Mr. J. H. Webster, a further heading was added, namely (h) The method of control of gas and air.

Mr. J. H. Webster observed that too many pot furnaces and tanks suffered from insufficient control. It was quite a common thing to find neither gas nor air control. The question of the number of dog holes was under consideration. He had seen tanks with as many as four and the introduction of four was an easy proportion and could assist in overcoming those imaginary currents which were said to be set up in tanks having one dog hole. With regard to heat losses these were discovered at three important places, (1) producer, 17 per cent, (2) furnace structure, 40 per cent and (3) chimney flues, 28 per cent. Fifteen per cent seemed to be the best figure obtained for heat utilized in actual practice. Reference was also made to waste heat boilers and to powdered fuel.

TENTH ANNUAL GENERAL MEETING.

The tenth annual General Meeting was held in Sheffield, on April 27, 1927, the President, Mr. Walter Butterworth, Senior, M.A., in the chair.

Mr. Butterworth was relected President and the following officers were elected to fill vacancies arising in accordance with the Society's "Constitution and Rules."

*Vice-Presidents*—H. A. Bateson and W. J. Ross.

*Ordinary Members of Council*—J. D. Cauwood, F. Graves Clark, Miss V. Dimbleby, G. V. Evers, and W. W. Warren.

*Honorary Treasurers—General,* Joseph Connolly; *American,* F. C. Flint.

*Honorary Secretary*—Prof. W. E. S. Turner.

*Auditors*—C. S. Davey and D. Wood.

In the tenth annual report of the Council it is stated that Dr. W. Rosenhain had been invited to write the first and Prof. E. Zschimmer of Karlsruhe to write the second of the annual reports on the progress of glass technology contemplated for the G. R. A. Trust and that both had accepted.

Prof. Turner gave data of numerous tanks working for hand operation, for semi-automatic bottle machines, for mixed automatic and semi-automatic machines, and for fully automatic machines. Among the problems which still required more thorough examination were:

(a) Design of ports. End ports in some cases appeared to give longer life to tank blocks;

(b) Bridges, the form of the basin and whether there should be one or two dog-houses.

(c) Depth of the refining end of the tank, whether it should be less than at the melting end;

(d) Utilization of waste heat, and

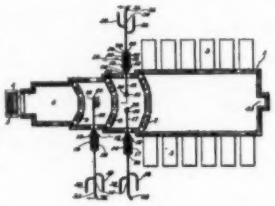
(e) Increased insulation in various parts of the furnace, crown, side walls, etc.

# Recent Patents

**NEW INVENTIONS DESIGNED TO IMPROVE GLASS AND THE MEANS OF PRODUCING IT**

**Complete copies of U. S. Patent Specifications may be obtained from the Commissioner of Patents, Washington, D. C. Price 10c each**

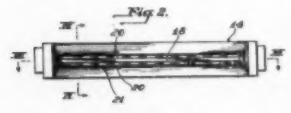
PROCESS AND MANUFACTURE FOR MELTING GLASS. U. S. 1,631,204. June 7, 1927. Halbert K. Hitchcock, Pittsburgh, Pa., assignor to Pittsburgh Plate Glass Co. Filed 10/16/26. Involves the use of water vapor cooling means in the tank intermediate the melting zone and the delivery zone. The cooling liquid is supplied by atomizing, or spraying, the water into the space between the glass bath and the arch of the furnace, the finely divided liquid being preferably directed upward and laterally rather than downward. This procedure permits the melting end of the tank to be run at a much higher temperature than is ordinarily done in a tank furnace without causing an increase in temperature in the other end to a point unsuitable for rolling so that the capacity of the tank is materially increased.

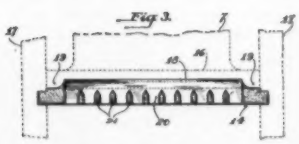


PROCESS AND APPARATUS FOR FEEDING GLASS. U. S. 1,628,324. May 10, 1927. Wm. J. Miller, Swissvale, Pa., assignor to Hartford-Empire Co. Filed July 22, 1921. In glass feeding mechanism, the combination of a receptacle for molten glass provided with a discharge orifice, means reciprocating within said receptacle for propelling the glass through said orifice, and a rotary stirring tool immersed in the glass within said receptacle, for the purpose described.

MOLD FOR CASTING CLAY BLOCKS AND THE LIKE AND METHOD OF MOLDING. U. S. 1,625,947. Apr. 26, 1927. J. M. Lambie and D. W. Ross, Washington, Pa. Filed 1/10/25. A system for casting ceramic articles whereby it is possible to cast large tank blocks two feet or more in thickness, is claimed in the copending application for Letters Patent, Serial No. 757,422, filed December 22, 1924. The present patent deals with the structure of the molds employed. By making the porous walls as thin as possible, with due regard for strength, and having their external surfaces exposed to the air, drying goes on rapidly and satisfactorily. The porous material is mounted in a frame and backed up with just sufficient lattice work to keep it from bulging outward while in service. By the use of the molds described it is possible to mold blocks so accurately that substantially the only surfacing necessary is that required to remove sufficient material from the tops of the blocks so that they will be the proper height after firing.

APPARATUS FOR DRAWING SHEET GLASS. U. S. 1,631,319. June 7, 1927. Joseph S. Gregorius, Mount Vernon, O., assignor to Pittsburgh Plate Glass Co. Filed 10/21/27. Improved draw bar for use in vertical sheet drawing operations adapted to reduce the tendency toward devitrification, to more postively define the position of the sheet in the bath, and maintain such sheet flatter than has been done by the draw bars heretofore employed; and to assist in maintaining the temperature of the layer of glass above the bar, from which the sheet is generated, more uniform from one side of the bath to the other.

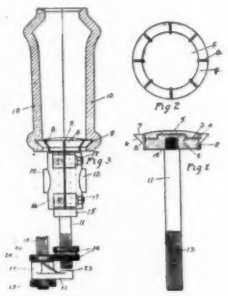



GLASS-ROD-CUTTING MACHINE. U. S. 1,626,851. May 3, 1927. H. DeForest Madden, Newark, N. J., and John J. Higgins, assignors to Westinghouse Lamp Co. Filed 1/2/22. A machine for severing a glass rod comprising a pair of cutters, means for rotating the rod, means for rotating the cutters and means for changing the relative positions of said cutters and rod to bring the cutters in contact with the rod, said last mentioned means operating to gradually increase the degree of contact between the cutters and rod to produce a peripheral groove partly severing the rod, the gradual increase in the degree of contact effecting a generation of heat at the base of the groove causing a complete division of the rod.

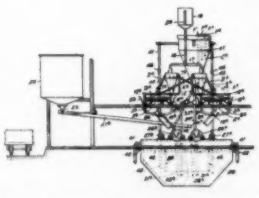
METHOD OF MAKING REFRACTORY BLOCKS. U. S. 1,626,261. April 26, 1927. Paul G. Willetts, assignor to Hartford-Empire Co. Filed 10/13/26. The process of producing a refractory block having equal opposite faces that comprises making one of such faces smaller than the opposite face, and firing the block upon a substantially non-shrinking support with said smaller face down.

GLASS-FORMING APPARATUS. U. S. 1,631,633. June 7, 1927. Orin A. Hanford, Columbus, O., assignor to the Federal Glass Co. Filed 7/9/23. The inventor has discovered that in forming the bottom of blown tumblers, etc., far better results can be obtained by the provision of a bottom plate constructed either partially, or wholly, of a porous substance for directly controlling the forming and cooling of the glass blank, instead of the ordinary wooden plate. The treatment is such that the porous substance such as plaster of paris will always absorb and contain a sufficient amount of fluid to cool the desired portion of the glass blank, and prevent any overheating.




BOTTLE-TRANSFER MECHANISM. U. S. 1,626,748. May 3, 1927. M. J. Owens, deceased, by Administrators, to Owens Bottle Co. Filed 9/20/24. The combination of a glass forming machine comprising automatic means for periodically discharging bottles neck end downward in groups, means for receiving said bottles comprising holders individual to the bottles and arranged to receive them as they are discharged from said machine and hold them in spaced relation, and means to actuate said holders and simultaneously release all the bottles of a group therefrom.

APPARATUS FOR GRADING ABRASIVE AND APPLYING SAME TO CONTINUOUS GRINDING SYSTEMS. U. S. 1,629,502. May 24, 1927. Halbert K. Hitchcock, Pittsburgh, Pa. Filed 11/3/24. One object is to provide a system having all of its parts in duplicate and so arranged that both sets of parts will normally be in use, but so designed that in case either half, or any part thereof, of the abrasive supply system is shut down or incapacitated from any cause, the entire grinding system can be supplied with abrasive from the remaining half of the abrasive supply system, the capacity of each half being sufficient for this purpose.



GLASS-FORMING MACHINE. U. S. 1,626,703. May 3, 1927. L. D. Soubier, assignor to Owens Bottle Co. Filed 11/15/20. Relates to construction and arrangement of molds each adapted to receive a plurality of mold charges at the same time.

SHEET GLASS DRAWING APPARATUS. U. S. 1,626,396. April 26, 1927. John L. Drake, assignor to Libbey-Owens Sheet Glass Co. Filed 8/2/26. In sheet glass apparatus, a draw table having substantially solid portions and open portions, said substantially solid portions extending the entire width of the draw table, and means engaging the open portions for driving the said draw table.

CONVEYING APPARATUS. U. S. 1,626,738. May 3, 1927. Richard La France, assignor to Owens Bottle Co. Filed 4/22/24. Apparatus for receiving bottles, jars or other glass articles as they are discharged from a forming machine and carrying them away from the machine.

GLASS-FABRICATING APPARATUS. U. S. 1,629,455. May 17, 1927. William J. Miller, Swissvale, Pa., assignor by mesne assignments to William J. Miller, Inc. Filed 9/10/23. Means for inverting the mold, after the fabrication of the article therein, so that the latter will tend to drop down out of the mold; and for then returning the mold to its upright position ready to receive another gather or gob of molten glass preparatory to the next fabricating operation. Also new and improved tapping means for jarring the inverted mold as an additional means for loosening the fabricated article which may stick to the mold, thus insuring its discharge from the inverted mold.

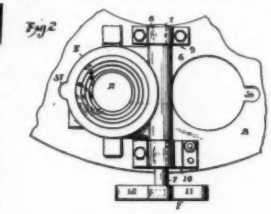
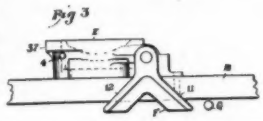
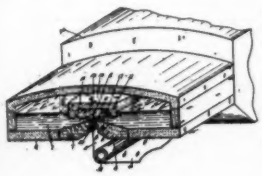


Fig 3



APPARATUS FOR FORMING GLASS. U. S. 1,626,702. May 3, 1927. L. D. Soubier, assignor to Owens Bottle Co. Filed 10/11/20. Charges of glass are simultaneously introduced into a plurality of molds and the several steps in the formation of the articles from said charges are carried on concurrently.

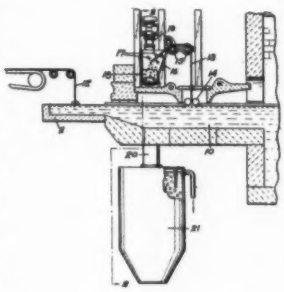
METHOD AND APPARATUS FOR PRODUCING SHEET GLASS. U. S. 1,631,804. June 7, 1927. Enoch T. Ferngren, Toledo, O., assignor to the Libby-Owens Sheet Glass Co. Filed 8/21/22. In the method of producing sheet glass by moving the glass downwardly, through an orifice in the molten-glass container, that step wherein the surface portion of the molten glass directly overlying the orifice is isolated from the main body of glass and an increased surface tension is created in this isolated section, by providing spaced clinging surfaces to which the edges of the isolated body of glass may adhere.



METHOD OF PRODUCING FIRED CERAMIC BLOCKS. U. S. 1,626,260. April 26, 1927. Paul G. Willetts, assignor to Hartford-Empire Co. Filed 10/23/26. Clays and other selected ingredients are combined to form a dense, homogeneous and finely grained material, typically consisting of mullite and a small amount of vitreous slag. The temperatures employed for firing these bodies frequently exceed 3,000 deg. F. When a rectangular block of considerable size is fired at such high temperature upon an ordinary pallet, the portion of the block adjacent to the pallet shrinks less than the portions which are further removed from the pallet during the firing operation. Therefore, a block that is perfectly rectangular when placed in the kiln will be substantially smaller at its upper end than at its lower end when the firing is complete. The inventor claims the method of manufacturing refractory blocks such as flux blocks having substantially equal opposite faces from material which, when heated to maturity on a rigid support tends to shrink less near its lower face than in its upper portions, which method comprises the steps of placing the block for firing upon a support composed of material entering into the composition of the said block, which support, during firing, will shrink at least as much as said block.

GLASS-FORMING MACHINE. U. S. 1,632,632. June 14, 1927. Leonard D. Soubier, Toledo, O., assignor to Owens Bottle Co. Filed 8/20/21. In a glass forming machine, the combination of a rotary mold carriage, molds thereon, a head adapted to cooperate with the molds in succession, automatic means to cause said head to advance with a mold and then return and advance with a succeeding mold and means for moving said head toward and from the axis of the mold carriage into and out of position over the mold with which it is advancing.

METHOD AND MEANS FOR SKIMMING GLASS. U. S. 1,631,759, June 7, 1927. Warren A. Rhoades, Shreveport, La., and Thomas C. McKinley, Charleston, W. Va., assignor to the Libby-Owens Sheet Glass Co. Filed 7/22/27. Means for skimming the surface of molten glass, containing dirt or scum which is detrimental to the finished sheet which is drawn. The sheet may be drawn from the cooling chamber or refining end in a similar manner to that in which the commercial sheet is drawn. If desired, the rotatable knurled rolls which are commonly used, may be provided to insure that a sheet be drawn, thus skimming the glass across its entire width. The sheet may be deflected over the rolls and run into a hopper where sprays of cold water may be applied to the hot glass, cracking it up to form cullet.



GLASS-DRAWING APPARATUS. U. S. 1,631,138. June 7, 1927. Walter G. Koupal and Joseph Gregorius, Mt. Vernon, O., assignors to Pittsburgh Plate Glass Co. Filed 10/14/26. Improvement on edge holding means of the type disclosed in the Koupal Patent No. 1,580,140 of April 13, 1926 and the Gregorius Patent No. 1,596,654 of Aug. 17, 1926.

GLASS-DRAWING MACHINE. U. S. 1,631,097. May 31, 1927. Raymond D. Hurley and Brooke H. Patton, Clarksburg, W. Va., Assignors to Rolland Glass Co. Filed 6/24/25. A glass drawing apparatus comprising means for establishing a pool of molten glass, guides arranged vertically over said pool means, a bait supporting carriage vertically movable between said guides, a lubricant pocket formed in the upper end of each of said guides each of said pockets having a conduit leading therefrom to the carriage-engaged surface of the guide. It is claimed that in practice by charging each pocket with a quantity of the lubricant paraffin once each shift of eight hours, the guides may be properly lubricated to such an extent that the life of the carriage shoes is enormously increased.

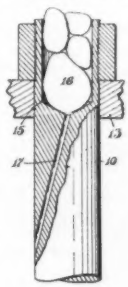
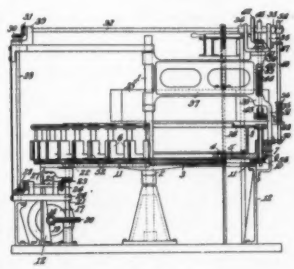


PLATE-GLASS TRANSFER AND LAYING APPARATUS. U. S. 1,631,203. June 7, 1927. Halbert K. Hitchcock, Pittsburgh, Pa., assignor to Pittsburgh Plate Glass Co. Filed 3/27/24. A vacuum lifting frame mounted for vertical movement over each track, and a turnover frame mounted for lateral movement between the two frames.

MACHINE FOR FINISHING PRESSED-GLASS ARTICLES. U. S. 1,629,827. May 24, 1927. Raymond T. Kimble, Cambridge, O., assignor to the Cambridge Glass Co. Filed 10/30/25. The primary object of the invention is to provide in a machine for fire-finishing and polishing pressed glass door knobs, automatic mechanism whereby such door knobs are re-pressed in or during the fire finishing and polishing treatment to which they are subjected, thereby to obviate the necessity for the re-heating and re-pressing operations heretofore uniformly resorted to as steps preceding that in which they are acted upon for effecting fire-finishing and polishing.



APPARATUS FOR GUIDING AND CONVEYING GLASSWARE. U. S. 1,626,747. May 3, 1927. M. J. Owens, deceased, by Administrators, to Owens Bottle Co. Filed 3/22/24. Means for receiving and guiding the individual articles separately as they are discharged from the molds and keeping them out of contact with each other until they have cooled sufficiently.

SHOCK-RESISTING GLASS. U. S. 1,632,364. June 14, 1927. William C. Bull, Brooklyn N. Y. Filed 3/15/26. A laminated glass product composed of sheets of glass held together by a transparent membrane and at least one of said sheets containing therein only spaced strands of disconnected wires in non-crossing relation.

GLASS AND PROCESS OF MAKING THE SAME. U. S. 1,633,534. June 21, 1927. Bernard Long, Paris, France, assignor to Sociéte Anonyme des Manufacturers des Glaces & Produits Chimiques de Saint-Gobain. Filed 1/12/26. A glass having high absorption for short rays such as the X-rays, containing a large percentage of X-ray absorbing oxides tending to decrease changes of fluidity of the glass with change of temperature conditions, and also containing zirconium oxide.

APPARATUS FOR SEPARATING MOLTEN GLASS INTO MOLD CHARGES. U. S. 1,629,409. May 17, 1927. Karl E. Peiler, West Hartford, Conn., assignor to Hartford-Empire Co. Filed 3/7/22. The combination of a container for glass having a submerged discharge outlet, means for regulating the weight of the charges independently of their shape, including a weight regulating member projecting into the glass over the outlet, a shape controlling plunger projecting into the outlet, and means for imparting periodic movements to the plunger.

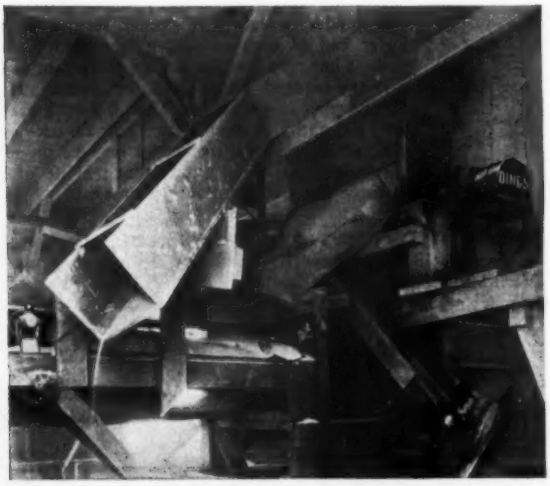
PLATE-GLASS SURFACING CAR. U. S. 1,631,126. June 7, 1927. Alfred L. Harrington, of Rosslyn Farms, Pa., assignor to Pittsburgh Plate Glass Co. Filed 1/22/24. Means for maintaining the top surfaces of the abutting ends of two cars flush.

# Glass Factory Equipment and Supplies

**Most of the information printed in this department comes direct from the manufacturers of the products described.**

## An Unusual Method of Magnetic Separation

An unusual method of separating from glass sand all magnetic material, such as hematite, magnetite, ilmenite, minute particles of iron abraded from the surfaces of crushers, screens or other iron machinery and even particles of iron attached to sand cystals, or entirely included in them, has been installed in the plant of the United States Silica Company of Ottawa, Illinois. The process, which is used in the manufacture of a sand of extremely low iron content necessary to meet the requirements of glass manufacturers where the color of the glass is of importance, has been developed in order to submit large quantities of sand to the highest possible magnetic intensity and makes use of a large capacity magnetic pulley with the material passing directly over the bare face of the pulley instead of over a belt as is the usual practice.



DINGS MAGNETIC SEPARATOR

The sand which is originally obtained by the disintegration of a high grade sandstone is first submitted to intensive washings which eliminate the alumina and other non-magnetic materials contained in the sandstone. The sand is then fed by gravity from a large hopper in a thin stream, directly onto the bare face of a 48" Dings magnetic pulley on which the maximum current is carried. The extremely high magnetic intensity causes all particles of magnetic material such as hematite, magnetite, iron of abrasion, etc., to adhere to the face of the pulley including even the crystals with iron attached or iron entirely included within themselves.

In order to remove magnetic particles collected on the face of the pulley a special control mechanism has been installed which demagnetizes the pulley for a few seconds approximately once every minute. At the same time a stiff brush extending the full width of the pulley is brought to bear against the pulley face on the back side. This brush, operating while the pulley is demagnetized for a second or two removes all magnetic particles which have been seized, the collected magnetic particles falling into another chute.

Immediately after the face of the pulley has been brushed clean the magnetizing current is again applied by the automatic control mechanism. The entire cycle is repeated approximately once a minute.

The design of the apparatus and automatic control was worked out by engineers of the Dings Magnetic Separator Company of Milwaukee working in co-operation with the U. S. Silica Co. Approximately 75 tons of sand per hour are handled by the separator.

The character of the metallic iron separated from the sand in this manner is exceedingly fine consisting for the most part of the minute mill abrasions from screens, pipes, etc. In addition, of course, all larger particles of tramp iron which may have accidentally been introduced into the sand are separated out.

The process has been made necessary due to the fact that the Ottawa plant manufactures a glass sand which is sold on a guarantee that the iron content will not exceed a definite fixed percentage of iron oxide. Each batch of sand is accompanied by an analysis of iron oxide made as a matter of routine by the Robert W. Hunt Co. and over a period of 13 months an average iron oxide content of .0184 per cent has been maintained. The highest iron oxide content reported over this period was .025 per cent and the lowest was .009.

Maintenance of iron oxide content at these low levels is necessary in the manufacture of high grade glass sand since very small quantities of iron in a batch of glass causes discoloration of the product. Due to the fact that modern glass manufacture calls for continuous process in the melting of the ingredients used the occurrence of small quantities of iron oxide in a single batch is likely to discolor a large quantity of glass.

## Uranyl Carbonate in Glass

The Vitro Manufacturing Company, Pittsburgh, Pa., are featuring their uranyl carbonate of sodium ($Na_2CO_3$) ($UO_2CO_3$). This material is yellow in color but turns orange when heated. It contains 45 per cent $U.O_3$. Since the introduction of this material by the Vitro concern sometime ago it has been found that many glass manufacturers prefer it to sodium uranate, though the price is lower, results are said to be the same or better. It gives greater brilliancy to the glass, it is claimed, due to the fact that uranyl carbonate of sodium dissolves more easily and the carbonic acid escaping during smelting effects better diffusion.

Uranyl, as well as uranate, produces the fluorescent coloring of the uranglass. Reflected, this color is greenish yellow but a beautiful emerald green when held against the light. In batches containing lead, both uranyl and uranate produce orange glass.

In opalescent and opaque glass the color produced by uranyl carbonate is yellow. Boric acid added gives a lemon-yellow color. By adding oxide of zinc, brilliant orange red and even crimson can be obtained.

# The Glass World and What It Is Doing

## News of the Industry

### Tariff Investigation of Fluorspar

Notice has been given by the United States Tariff Commission that a public hearing to ascertain the facts with regard to domestic and foreign costs of production of fluorspar will be held at the office of the Commission at Washington, D. C., at 10 a. m, July 22, 1927. The Commission has issued a preliminary statement containing information on the subject collected from various sources and has included a list of problems for discussion.

The statement contains a discussion of fluorspar, its production, uses and production costs. According to this report commercial fluorspar is graded as acid, ceramic, and metallurgical spar, according to its contents of calcium fluoride and various impurities, and by the size of its particles, as lump, gravel and ground spar.

The acid spar is highest in grade and contains not less than 97 per cent calcium fluoride and not more than 2 per cent silica.

The next grade, ceramic, runs from 90 to 95 per cent calcium fluoride, 2 to 5 per cent silica, and 2 to 8 per cent calcite. Glass manufacturers use ground fluorspar of this grade as an opacifier in the production of white or opal glass. The imported ground spar used in the glass and enamel industries comes from Germany, Italy and British South Africa.

Metallurgical grades generally contain less than 85 per cent calcium fluoride and not more than 5 per cent silica.

The price of fluorspar as quoted in American trade journals is nominal, that is, it reflects what producers quote against casual inquiries rather than what they actually get for the spar sold. Shipments of the larger producers to their principal customers are generally on 3 or 6 months' contracts, so that the bulk of sales is not affected by temporary price fluctuations.

The average annual sales price of domestic shipment of ground spar varied during the period 1913 to 1917, inclusive, from $10.80 per short ton to $17.59. Since 1918 the prices have varied between $31.21 to $43.32. The average for 1926 was $32.26.

The report gives domestic cost of production, including the cost of mining, waste sorting, hauling, etc., and separate costs for lump, gravel and ground fluorspar. The cost of ground fluorspar is computed for material and grinding at $22.92 per short ton, without adding imputed interest. Selling costs are not included.

The ground ceramic fluorspar based on invoice price of imports from Germany into the United States in 1925, including costs of containers, is shown to average $24.60 per short ton at the port of entry.

A table covering sales distribution in 1925 of ground fluorspar by districts is given and it is shown that there was delivered to the glass trade in that year a total of 6,200 short tons of domestic ground fluorspar, and 317 short tons of imported ground fluorspar. Of the ground fluorspar produced and imported, 54.8 per cent was consumed in the glass trade, 35.3 per cent in the enamel trade and 9.9 in the manufacture of acid.

The principal markets for the sale of imported ground fluorspar for glass making was the Pittsburgh-Wheeling district, which took 65 per cent of the total, and Muncie Kokomo, 23 per cent.

The present import duty on fluorspar is $5.60 per ton, equivalent to $5.00 per short ton.

### More Investigations Affecting Glass Industry

In answer to an appeal made by James Maloney, president of the Glass Bottle Blowers' Association of the United States, that the Tariff Commission complete the investigation into the hand blown glass bottle industry, which was started in 1925 and discontinued temporarily, the Commission on May 26, 1927, ordered an investigation into the difference in cost of production here and abroad of perfumery and toilet bottles. The date for the public hearing will be announced later.

The Commission also, on the same day, ordered an investigation of the difference in domestic and foreign costs of production of "cylinder, crown and sheet glass, by whatever process made and for whatever purpose used, unpolished." The date of the public hearing will also be announced later.

Meantime, the Commission has announced that preparations are under way to have their investigators visit a large number of window glass plants throughout the country. J. Mark Albertson of the Ceramic Division of the Commission, who has had a great deal of experience as an investigator of plate glass production costs in connection with the preparation of the first and second preliminary statements prepared by the Commission for use at the public hearings held at Washington will, it is expected, take charge of the window glass matter. One of the first steps will be to determine the cost of producing window glass in the United States and an investigation of foreign costs will also be made. It will undoubtedly be late in the year before any public hearings on this subject are held.

On May 26 the Commission ordered an investigation along the same lines, of potassium permanganate.

### Big Glass Sand Merger Goes Through

Announcement has just been made of the completion of the merger of eastern sand companies in an organization with a Pennsylvania charter to be known as the Pennsylvania Glass Sand Corporation. The new combination will acquire the Pennsylvania Glass Sand Company, whose headquarters are at Lewistown, Pa., and the Berkeley Glass Company, Berkeley Springs, W. Va., the two largest producers from the Oriskany deposit, and the Maryland Glass Sand Company, West Virginia & Pittsburgh Sand Company, Pittsburgh White Sand Company, and E. F. Millard Sand Works; only the Hazel-Atlas Great Cacapon and National Silica Company remain outside.

Securities consisting of $5,000,000 of first (closed) mortgage 6 per cent sinking fund bonds, 30,000 shares of cumulative convertible stock without par value, and 300,000 shares of common stock will be issued. A. J. Fink of Baltimore, Md., will be chairman of the board of directors.

Involved in the transfer of the property of the constituent companies are a number of deposits in the United States and Canada of feldspar and this line, as well as the immense glass sand operations, will be developed.

### Two Factories Plan Move to Cambridge

At a mass meeting of the citizens of Cambridge, O., a proposition from the Christensen Agate Company of Payne, O., the original manufacturers of glass marbles, and the Gilligan Glass Products Company of New Philadelphia, Pa., manufacturers of automobile headlight bulbs, to move their manufacturing plants to Cambridge, was unanimously accepted and plans for a campaign to raise about $17,100 to finance the change was enthusiastically endorsed. The proposition made to the city by the two glass companies involves the payment to the Gilligan concern of a $10,000 bonus and free site for its plant and a $5,000 bonus and building site for the Christensen Agate Company. Their decision to locate in Cambridge is said to have resulted partly on account of the possibility of obtaining a low rate for natural gas as a result of extensive developments in the Guernsey County oil and gas field and it is said that gas has been assured at the rate of 22½ cents per thousand cubic feet. E. D. Shively, secretary of the Cambridge Board of Trade, stated late in June that the money had practically all been raised and the deal will be completed shortly. It is expected that the establishment of the two new plants in Cambridge will add about 1,000 to the city's population.

### Celite Products Company Wins Patent Suit

The United States district court of the Southern District of California issued a final decree in the suit filed by the Celite Products Company (manufacturers of Sil-O-Cel Heat Insulation) against The Featherstone Insulation Company for the infringement of United States Letters Patent 1,076,126 and 1,184,184.

The trial was held in Los Angeles last year, the final decree issuing on May 13, 1927. The Court held both patents valid and infringed by the defendant. Patent 1,076,126 pertains to a molded

diatomaceous insulating brick manufactured and sold by The Celite Products Company under the trade-name Sil-O-Cel C-22. Patent 1,184,184 pertains to a composition consisting of a calcined diatomaceous aggregate (manufactured and sold by The Celite Products Company under the trade name Sil-O-Cel C-3) and a binder. Very often the binder used is Portland cement, the resulting composition being known as Sil-O-Cel C-3 concrete.

### Offers Site and Bonus for Glass Factory

U. I. Jenkins, secretary of the Jane Lew Brotherhood, of Jane Lew, W. Va., announces that the town is anxious to have a glass factory locate there and is offering for a site a fine plot of ground between the B. & O. R. R. and the trolley line, to which it would be easy to construct a switch from one or both roads. It is stated that an unlimited supply of gas at 30 cents per thousand will be furnished. An abundant supply of electric power is also available. The town has less than 1,000 inhabitants, but is so situated that from 75 to 100 laborers could be obtained. Those interested are willing to give rather liberally in land and cash to secure a properly managed glass industry, or would take some stock in an enterprise of this kind.

### Australian Glass Manufacturers Ask Higher Tariff

The Crown Crystal Glass Company, Ltd., of Sydney, Australia, has applied to the Australian Tariff Board for an increase of 20 per cent on the present tariff on British glassware and 35 per cent on other foreign glass. In presenting the application, J. H. Downey, assistant manager of Crown Company, stated that the principal imports came from Belgium, Germany, Japan and Czechoslovakia and that this competition had resulted in the closing of a number of factories in recent years, and he believed that at present there were only two glass factories in operation in Australia.

### Glass Makers of Czechoslovakia Form Cartel

Negotiations have recently been resumed in the Gablonz small glass industries which are expected in that country to lead to the formation of an export cartel to include all manufacturers and exporters in that line, according to advices to the Department of Commerce from Prague, Czechoslovakia. Unsuccessful efforts have been made at various times to organize the industries into a syndicate in order to eliminate undue competition and to check the price decline which has been practically continuous since the war, especially in bangles, buttons and artificial pearls.

### Plate Glass Production for May

Figures compiled by P. A. Hughes, secretary of the Plate Glass Manufacturers of America, show that the production of polished plate glass for the month of May, 1927, was 9,618,273 square feet. This is a decrease of 681,203 square feet, about 6½ per cent, from the April production, and 1,410,352 square feet, about 12 per cent, from the May, 1926, production of 11,028,625 square feet.

### Building Trade Conditions

May building and engineering contracts continued in very satisfactory volume, according to the F. W. Dodge Corporation review of building operations. Last month's contract total for the 37 States east of the Rocky Mountains (including about 91 per cent of the country's total building volume) was $552,348,500. This was only 9 per cent under April and it was about half of one per cent over May of last year.

### Production of Feldspar in 1926

The crude feldspar sold or used by producers in the United States in 1926 amounted to about 209,600 long tons, valued at about $1,607,000, or $7.67 a ton, according to reports obtained directly from producers by the United States Bureau of Mines, Department of Commerce. These figures show an increase of 13 per cent in quantity and 22 per cent in total value compared with 1925, and represent the largest production and value ever recorded.

### Belgian Glass Trade Worried

The Antwerp correspondent of the London *Times* says French proposals for increased duties on glass are causing anxiety to Belgian manufacturers.

### Reported Cryolite Discovery Not Confirmed

Press reports to the effect that deposits of cryolite of suitable quality for use in glassmaking had been discovered recently in Colorado were not confirmed when referred to Prof. Russell D. George, State Geologist, at Boulder, who stated that while cryolite occurs north and west of St. Peter's Dome, in El Paso County in the mountains about ten miles southwest of Colorado Springs, the quantity is very small and it is doubtful whether any attempt at development would be commercially successful. The quality of the cryolite is good. It has also been reported to occur from a point near the Cripple Creek mining camp. Here also the occurrence is extremely meagre and probably of no commercial value.

### Production of Sodium Sulphate Plant

The production of sodium sulphate at the plant of the Sodium Products Corporation at Camp Verde, Arizona, described in the June issue as being 120 tons a day, has, according to R. W. Coad, president, been increased since the article was written to 150 tons per day.

## Trade Activities

**The Standard Plate Glass Company** has resumed operations in their Springdale, Pa., plant after a shutdown lasting several months.

**The First Bohemian Glass Works, Ltd.,** it is announced by F. J. Lissman & Company of New York, will pay 10% dividend for 1926 to common stockholders.

**Standard Paint & Glass Company,** Baton Rouge, La. Capital, $10,000. Incorporators: Waldo B. Utley, Thomas T. Wright, Karl Schneidau.

**Amthor Designed Glass and Mirror Company,** Buffalo, N. Y., glass mirrors, etc. Capital, $25,000. Incorporators: William A. Amthor, Christina Amthor and August Schmukal.

**The Pittsburgh Glass Manufacturing Company,** Pittsburgh, Pa., has been incorporated by F. R. Murdock, George Roth and S. A. Greenlee to sell glassware and kindred products.

**Union Glass Sales Company,** Okmulgee, Okla. Capital, $25,000. Incorporators: R. E. Jenness, John M. Wesner and Pearl R. Burdsall.

The Butler, Pa., local papers report that the **Pittsburgh Plate Glass Company's** Works No. 5 at Ford City, Pa., closed down early in June on account of lack of orders and full warehouse.

**The Braddock Glass Company,** Cumberland, Md., was recently incorporated with a special stock of $25,000 by Carl L. Borchert, Louis H. Borchert and Calvin E. Deal. The company will manufacture flint glassware.

**The Louis Glass Company,** East Weston, W. Va., has changed its pink glass over to the older and larger tank and is using their new tank for crystal glass. The change, the company reports, is due to the demand for colored glassware.

**The H. C. Fry Glass Company,** Rochester, Pa., in compliance with the request of creditors and stockholders, will continue in the hands of Edward T. Davis as receiver. Mr. Davis was appointed to the receivership on June 1, 1926.

**The Whitall-Tatum Company,** manufacturers of bottles, has moved its New York City warehouse and office from 46 Barclay street, where it has been located for the past fifty years, to larger quarters at 225 Varick street.

**Acme Glass Company,** Lumberport, W. Va., has been incorporated with a capital stock of $100,000 by V. L. Hornor, James M. Guiher, J. H. Knight, E. P. Boggess and Phillip P. Steptoe, all of Clarksburg.

**United Glass Company,** 3819 W. Harrison Street, Chicago, Ill., has been incorporated with a capital of $50,000 to manufacture and deal in glass, glass novelties, etc. Incorporators are: E. A. Cassin, D. H. Rabinowitz and Michael Schneider.

Reconstruction work on the plant of the **Standard Sheet Glass Company,** formerly the Eldred Window Glass Company, Punxsutawney, Pa., is reported to be progressing and it is expected that the building will be completed sometime in July and that manufacturing operations will start early in the fall.

**The Cameron Glass & Manufacturing Company,** Cameron, W. Va., producers of lamp chimneys, lighting globes, headlight lenses, etc., recently put 12 more shops to work and are now operating their machine pressed department in full. The lamp chimney department will, as usual, close during July and August for repairs.

**The Auburn Glass Company,** Chicago, Ill., has purchased a five-acre tract on the south side of 81st street, extending to Hoyne avenue, on which it plans to erect a new plant although the company announces such plans will not mature until next year. The improvements will probably represent an investment of about $250,000.

**The Acme Glass Company's** new building at Olean, N. Y., which is being constructed under the supervision of the Toledo Engineering Company of Toledo, O., is nearing completion, and glass manufacturing operations will begin early in the fall. The building is 420 feet long and 68 feet wide and will contain more than 250 tons of steel which is being erected by the Blaw-Knox Company of Pittsburgh.

**The Brilliant Glass Products Company,** Brilliant, O., has arranged with the Chamber of Commerce of Weston, W. Va., to acquire a site, build a new plant and transfer their manufacturing operations to that center. The company manufactures automobile and railway signal lenses, ship lantern glass, flash light glasses, bath room fixtures, radiator insulators, carburetor bowls, and other lines. W. M. Mathews is general superintendent.

**The E. G. Chase Manufacturing Company,** Smethport, Pa., recently organized to make sectional colored glass masks for electric light bulbs, has arranged with the L. J. Houze Convex Glass Company to furnish their requirements of glass. The organization of the company has been completed and includes the following: Earl G. Chase, president; J. C. Backus, vice-president; and E. E. Drake, treasurer. Directors include: E. E. Drake, J. C. Backus, L. E. Munn, Sanford L. Fry, John A. Lindholm, Earl G. Chase, all of Smethport, and Theodore Phalon, of Eldred.

**The National Association Lighting Equipment Dealers** has been consolidated with the Artistic Lighting Equipment Association, the better to unify and simplify their operations. This places the Artistic Lighting Equipment Association in a strong position in the electrical field, for within its membership, now operating as special groups, are the following: lighting fixture manufacturers, illuminating glassware group, stamping and parts manufacturers group, exterior lighting and lantern group, dealers group, and miscellaneous group composed of manufacturers of lacquers, finishes, wiring devices, incandescent lamps, fixture parts, etc.

**Butterworth Bros., Ltd.,** Manchester, England, makers of every kind of industrial glass and of fine table glass, announced several weeks ago that they had arranged with Robert B. Clarke & Company, 302 Oxford Road, Manchester, for the transference to the Buterworth firm of their glass lamp blowing business. The plant, staff and stock in trade has been taken over. Robert B. Clarke & Company, who are manufacturers of scientific instruments, have retired from the glass lamp blowing business. They were probably the largest of all British manufacturers of lamp blown scientific glassware, and the Butterworth concern intends to develop the business still further.

**The Mission Glass Company,** San Fernando Road, Burbank, Cal., recently organized, has purchased a plant adjoining the Empire China Company, approximating 5½ acres with 66,000 square feet of factory space, and are installing equipment for the manufacture of street and interior glass lighting ware, tumblers and visible gasoline pump cylinders. H. A. Schnelbach, for sixteen years superintendent of the Macbeth-Evans Glass Company, Pittsburgh, Pa., and more recently secretary of the Jefferson Glass Company, Follansbee, W. Va., will have charge. The new company, it is said, will be the first to manufacture illuminating ware west of the Rocky Mountains. About 45 persons will be employed at the start.

**The Zihlman Glass Company** have practically completed the installation of furnaces, lehrs and other necessary equipment in their new factory at Cumberland, Md., and operations began a few days ago. Four continuous 10-ton gas-fired tanks have been erected. The factory building is 60 by 120 feet, of steel and concrete construction. Blown tumblers, tableware and art glass will be specialized in. It is said that six shops at least will be put on within a short time. Albert E. Zihlman is president of the company, James J. Kirk, vice-president, and Congressman F. N. Zihlman is one of the stockholders. In addition to the Zihlman factory, Cumberland's other glass manufacturing plants include: Maryland Glass company, Potomac Glass Works, Braddock Glass Works, which began operations May 1, and the Borchert Glass Company, which manufactures etched ware. Nearby at Lonaconing, is the Utility Glass Works, manufacturing high grade glassware.

**The Illinois-Pacific Glass Corporation,** San Francisco, Cal., expects to commence construction, late in the summer, of its new bottle manufacturing plant at Los Angeles which will have an initial capacity of 250,000 gross of bottles and is expected to be in operation within a year. Last year the company acquired a factory site in the Vernon manufacturing district, large enough to permit of enlarging its manufacturing capacity to 650,000 gross as soon as the demand warrants doing so. It it said that the company will save $100,000 in freight charges, and by segregating the manufacture of different types of bottles in its two factories, a further saving of $50,000 per year is anticipated. The company makes containers for milk, for packing purposes, beverages, medicine, mineral waters and oils. For the year ended November 30, 1926 the net profit of the company amounted to $403,794, after providing for depreciation and reserve, including Federal taxes. A courtesy offering of a block of the company's stock was made to the public in Los Angeles recently.

## Personals

**James D. Bracken,** vice-president and superintendent of the Federal Glass Company, Columbus, O., has retired from active service after 27 years with the company. At a banquet given by the company's executives and foremen, a Masonic ring was presented to Mr. Bracken through F. J. Blackburn, assistant superintendent.

**Theodore Schwing** has become connected with the Dunbar Flint Glass Company, Dunbar, W. Va., as plant manager. Mr. Schwing was for several years factory manager of the New Martinsville Glass Company, New Martinsville, W. Va., and until recently manager of Factory K of the United States Glass Company, Pittsburgh, Pa. According to Mr. Schwing the Dunbar company is erecting two day tanks in addition to the present ten-ring continuous tank, to be used for colored

## Recent Deaths

### T. C. Francis Hart

T. C. Francis Hart, treasurer and general manager of the Hart Glass Manufacturing Company and one of the leading citizens of Dunkirk, Ind., died at his home, May 26, from a paralytic attack caused by the bursting of a blood vessel. Mr. Hart, who was 45 years of age, went to Dunkirk about 1916, having previously been engaged in the oil business, to take the management of the Hart Glass factory, which he rebuilt and developed into a model factory.

### Henry P. Sinclaire

Henry P. Sinclaire, 63, for many years a manufacturer of cut and engraved glass in Corning, N. Y., and recently a manufacturer of art glass in Bath and pressed specialty lines in Dunkirk, was found dead in bed at his home in Corning on June 22. He complained of illness Wednesday and left his Corning office shortly before noon. Death probably occurred from acute dilation of the heart, according to physicians. Henry P. Sinclaire was born in New York City, August 14, 1864, the son of Henry Purden Sinclaire, Sr., then a resident of New York and later one of the founders of the Corning Glass Works. He is survived by his wife and by four sons, Robert O. Sinclaire of Hartford, Conn.; Douglas C. Sinclaire of Washington, N. J.; Murray Sinclaire of Dunkirk, N. Y., manager of the Dunkirk glass plant, and John Sinclaire of New York.

### D. C. Courtney

Dr. David H. Courtney, president of the Economy Glass Company, Morgantown, W. Va., died at his home in that city on May 27. Dr. Courtney, a member of one of Monongalia County's

pioneer families, was born at Maidsville, W. Va., in the year 1860. He was educated at West Virginia University and graduated with honors from Jefferson Medical College in 1886. While practicing medicine at Mount Morris, W. Va., oil was discovered in that vicinity, and foreseeing the possiblities of the industry he entered the oil and gas producing business. In 1901 Dr. Courtney was active in the organization of the Economy Glass Company at Morgantown. In 1913 he reorganized the Randall Gas Company, of which he was president at the time of his death. He was a director of the Bank of the Monongahela Valley, a vice-president of the Sesamine Coal Company, and was interested in other coal mining enterprises. He leaves his widow, two sons and three daughters.

## New Books

DEFECTS IN GLASS, by Dr. C. J. Peddle, with foreword by Professor W. E. S. Turner, Department of Glass Technology, University of Sheffield, 230 pages, 44 illustrations, size 8½ x 5½ inches. Published by Glass Publications, Ltd., Talbot House, Arundel street, Strand, London, W. C. 2. Price 8s. 6d. Post free.

In publishing this volume Dr. Peddle has made an important contribution to a more complete understanding of the greatest of all difficulties encountered in glass manufacturing, defects in glass. Of the many worries which beset the life of the glassmaker none is more persistent, and none appears to be more unavoidable. For this reason, every scrap of information regarding defects in glass has always been eagerly welcomed by glass manufacturers. The literature on this subject is voluminous, but nowhere has there been presented a more complete discussion as to the nature, causes and means of prevention of glass defects.

The author needs no introduction to the American glass manufacturing industry. His frequent contributions to the Journal of the Society of Glass Technology are well known in this country. The defects discussed in this volume are: Lack of Homogeneity, Bubbles and Seeds, Stones, Causes of Devitrification, Influence of Silica, Stabilizing, Oxides and Fluxing Oxides on Devitrification, Miscellaneous Defects During Meltnig and Working, and Faulty Annealing. The final chapter is given to a discussion of the Question of Durability.

The treatment of the subject of devitrification is very thorough, and more space is allotted to this question than to any other. This book deserves to be in the hands of every glass manufacturer. It is writen in a manner which appeals to the practical glassmaker as well as to the scientifically trained man, and contains information applicable in the fields of both workers.

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SPRECHSAAL KALENDER FÜR DIE KERAMISCHEN, GLAS-UND VERWANDTEN INDUSTRIEN, 1927 (Sprechsaal Yearbook for the Ceramic, Glass and Allied Industries), Edited by Dr. I. Koerner, published by Müller & Schmidt, Coburg, Germany. Size 6 x 4 in. Calender and Technical Part, the latter 196 pages. Bound in cloth. Price RM. 3.—

The new edition (in German) of the well-known "Sprechsaal Yearbook," which is the first to appear since 1925, contains a mass of valuable data for use of the glass maker and ceramist. In the technical part are found a number of tables, among them a list of atomic weights of inorganic substances, with factors for calculations. Of special interest to the glass industry are formulas for the etching and frosting of glass, preparation of acid resists, etching pastes, etching powder and etching ink. Also directions for silvering mirrors by various processes, and the making of copper and platinum deposits on glass. The chapters on glass contain a discussion of the ternary system $Na_2O,CaO,SiO_2$, tables for the calculation of the physical properties of glass and a discussion of the weathering of glass, with special reference to the work of Mylius. The "Sprechsaal Yearbook" in its latest edition will continue to prove its value to the glass manufacturer and ceramist and will undoubtedly gain new friends.

## Government Publication

PART II, NON-METALS, MINERAL RESOURCES OF THE UNITED STATES, 1923. Published by the U. S. Geological Survey, Department of the Interior. Frank J. Katz, Geologist in charge, Division of Mineral Resources. Government Printing Office, Washington, D. C., 1926. 5½ x 9 inches; 750 pages. Bound in stiff covers, uniform with earlier editions. For sale by the Superintendent of Documents, Washington, D. C., at $1.00 per copy. Contains chapters published separately on various dates, beginning 1924, on magnesium and its compounds, fluorspar and cryolite, clay, barium products, sand and gravel, potash, silica, lime, feldspar, abrasive materials, natural gas, coal, and other materials of lesser interest to glass manufacturers. Illustrated with maps and diagrams.

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THE LOVIBOND COLOR SYSTEM. I. A. Spectophotometric Analysis of the Lovibond Glasses, by K. S. Gibson and F. K. Harris. Scientific Paper of the Bureau of Standards No. 547, 46 pp., sold by the Superintendant of Documents, Government Printing Office, Washington, D. C. Price 15 cents.

This publication is the result of an investigation made with the purpose of standardizing, testing, and certifying Lovibond glasses, as it was found by many users that the Lovibond glasses are inconsistent among themselves.

A spectophotometric analysis of these glasses was made as a preliminary step in the Bureau's investigation of calibrating the glasses. Spectral transmission measurements were made on the unit glasses of the Bureau of Standards' set, from 1 to 20, inclusive, over a range from 380 to 750 mμ.

It was found that for all wave lengths which are of importance in the determination of the color of glasses, the following relation holds:

$$\text{Log. } T = kN + a$$

where T is the transmission at a given wave length, N is the Lovibond unit from 1 to 20 and k and a are constants.

The publication of the paper is not to be construed as a recommendation of the Lovibond method of specifying colors, nor of the theories on which the system is based. It is merely a study of the system, and an analysis of the set of Lovibond glasses in the possession of the Bureau of Standards.

## Industrial Publications

**Foreign Agency Agreements.** A pamphlet just issued by the American Foreign Credit Underwriters, Inc., 381 Fourth Avenue, New York City, by the direction of the trustees of the American Manufacturers Foreign Credit Insurance Exchange. The booklet, which has been prepared by William G. Marvin, senior partner of Marvin & Bergh, general counsel for the exchange, gives advice on how to avoid the pitfalls incident to doing export business through agents. Copies are available without cost.

**G. E. Products**—Bulletins have been issued recently by the General Electric Company, Schenectady, New York, describing the gear units applied with G-E centrifugal compressors for stepping up the speed of the prime mover to that required for the compressor. The higher speeds made available by the gears have not only increased the efficiency of the compressor but, by permitting a reduction in size, have decreased the cost. A further reduction in both initial and operating costs results from the fact that standard turbines, and more especially standard commercial motors, can be used as prime movers.

**The Guild Trichromic Colorimeter.** An instrument for the Analysis, Measurement and Specification of Color, designed by J. Guild, of the National Physical Laboratory (England). This publication is a 7 x 10 inch illustrated booklet, issued by Adam Hilger, Ltd., 24 Rochester Place, Camden Road, London, N. W. 1.

It describes a color measuring instrument, suitable for general application, developed by J. Guild of the Optics Division of the National Physical Laboratory, where the instrument has been under observation and in practical use since 1922. The instrument is claimed to be convenient and rapid in practice, and can be used with accurate results by any intelligent person, without special scientific training, necessary to an expert. While the three-color system is used, it is said to be free from defects from which intruments of this class have suffered in the past. All colors, including purples, can be readily measured and the majority of such colors may be reproduced on the instrument.

The booklet should be of interest to all concerned with the production of colored glassware, semaphore lenses, and to the artist in stained glass.

## Coming Meetings

THE AMERICAN FLINT GLASS WORKERS' UNION will hold its annual convention at Cambridge, O., on July 4.

THE GLASS CONTAINER ASSOCIATION'S summer meeting will be held at Clifton Hotel, Niagara Falls, Canada, on July 28 and 29.

THE AMERICAN BOTTLERS OF CARBONATED BEVERAGES annual convention will be at New Orleans, La., November 14 to 18, 1927.

THE NATIONAL GIFT AND ART ASSOCIATION will hold its fall exhibition at the Adelphia, Philadelphia, Pa., August 22 to 27. to 27.

THE AMERICAN CERAMIC SOCIETY'S next annual meeting will be held at the Ambassador Hotel, Atlantic City, N. J., February 5 to 11, 1928.

THE NATIONAL ASSOCIATION OF MANUFACTURERS OF PRESSED AND BLOWN GLASSWARE will hold a meeting at the Marlborough-Blenheim Hotel, Atlantic City, on Monday, July 18, and the AMERICAN ASSOCIATION OF FLINT AND LIME GLASS MANUFACTURERS will meet Monday afternoon, July 18, at the same place. The annual wage conference between the members of the National Association of Manufacturers of Pressed and Blown Glassware and the wage committee of the AMERICAN FLINT GLASS WORKERS' UNION will begin at the Marlborough-Blenheim on July 21.

## Glass Stock Quotations

PITTSBURGH STOCK EXCHANGE, JUNE 23, 1927

Reported by Moore, Leonard & Lynch, Union Trust Bldg., Pittsburgh, Pa.

| | Bid | Asked | Last |
|---|---|---|---|
| American Window Glass Machine, Com. | 35¼ | 36 | 35⅛ |
| American Window Glass Machine, pfd. | 70 | .. | 70 |
| American Window Glass, pfd. | .. | .. | 104 |
| United States Glass | 11 | 13 | 13 |
| Pittsburgh Plate Glass, com. | 230 | .. | 236 |
| Standard Plate Glass, com. | 3 | .. | 3¼ |
| Standard Plate Glass: | | | |
| Preferred cumulative | 13 | 20 | 15¾ |
| Prior preferred | 35 | .. | 35⅛ |

TOLEDO STOCK EXCHANGE, JUNE 22, 1927

| | Bid | Asked | Last |
|---|---|---|---|
| Owens Bottle Machine, com. | 117¼ | 119⅝ | 119¼ |
| Libbey-Owens Sheet Glass, com. | 132 | 133 | 132½ |
| Libbey-Owens Sheet Glass, pfd. | 115 | ... | 118 |

WHEELING STOCK EXCHANGE, JUNE 22, 1927

| | Bid | Asked | Last |
|---|---|---|---|
| Hazel-Atlas | 58½ | 59 | 59 |
| Imperial | .. | 40 | 72 |
| Fostoria | 190 | .. | 208 |
| Central | .. | 70 | 75 |

## Inquiries Received

*For further information address* THE GLASS INDUSTRY

376. We have an inquiry from the Philippine Islands for a grinding machine which can be used for cutting designs, letters, decoration, etc., on glass. Can you give us the names of manufacturers who are prominent in the production of this machinery? We would also appreciate information as to the names of manufacturers who produce acid-etching apparatus and supplies for glass work. (June 8.)

377. I would like to obtain the addresses of manufacturers who make glass shelves and pedestals. (May 26.)

378. We are interested in securing the names of glassware manufacturers in New York, New Jersey and Pennsylvania.

379 (Canada). We wish to get in touch with some firms manufacturing cheap and medium-priced table glassware who sell for export at a price that will allow a duty of 35% plus a sales tax of 5%, and which will still be reasonable in price. (June 20.)

380. Can you give us the name of firms making "whatfors," or glass globes from which watch crystals are cut? (June 20.)

381. We would like to obtain the names of manufacturers of pressed glass as used in pavement and concrete skylights, known as prismatic glass. We own some molds which we could supply to the manufacturer. (June 22).

## What The World Wants

*Specific Inquiries for American Goods Received in the Department of Commerce, Washington, D. C.*

Germany. 25622, glass-making machinery; 25977, window glass; 26028, glass beads.

Egypt. 25672, window and mirror glass.

Canada. 25711, blown and pressed glassware.

Philippine Islands. 25701, glassware, especially tumblers.

Cuba. 25760, glasses.

Java. 25901, laboratory glass equipment.

Mexico. 25981, glass bottles, whisky, one-half pint to one-fifth gallon.

## READERS WANTS AND OFFERS

### Positions Wanted

**Factory Superintendent.** Belgian, superintendent of a window glass factory using the Fourcault process, with long experience in the construction and management of furnaces and machines, desires a similar position in a mechanical window glass factory in the United States. Address, A. B. C., care THE GLASS INDUSTRY, 50 Church Street, New York.

**Graduate** of 4 year Ceramic Engineering course, University of Illinois, wishes a position with a glass company in which his technical training would be valuable. Age 21. Single. Best of references. Robert Lotz, 211 E. Daniel Street, Champaign, Ill.

### Used Machinery

**For Sale:** 3 Gas producers, 500 H.P. each; 1—Williams No. 5 Roller Knife Crusher; 2—300 H.P. Ball Erie, rope drive, engines, American system. Excellent condition. Write for particulars. Address, Box No. 5, care THE GLASS INDUSTRY, 50 Church Street, New York.


# WANTED!

## A glass industry of some kind

**to locate in**

## JANE LEW, W. VA.

An excellent site between trolley line and B. & O. R. R., close to each. An unlimited supply of gas at 30c. No other industries, hence, no labor troubles. Fifty to one hundred laborers can easily be secured.

### LIBERAL DONATIONS

Citizens will make liberal donations to right company, or will subscribe for stock, or both.

If interested, address

**Jane Lew Brotherhood, U. I. Jenkins, Secy.,**
**Jane Lew, W. Va.**

# Current Prices of Glass-Making Materials

June 23, 1927

Quotations furnished by various producers, manufacturers and dealers.

| | | Carlots | Less Carlots |
|---|---|---|---|
| **Acid** | | | |
| Citric (dom.) | lb. | .43½–.44½ | .44½–.46½ |
| Hydrochloric (HCl) 20° tanks, per 100 lb. | lb. | .. | .95–1.05 |
| Hydrofluoric (HF) 60% (lead carboy) | lb. | .. | .13½ |
| 52% and 48% | lb. | .10 | .10–.11½ |
| Nitric ($HNO_3$) 38° carboy ext. Per 100 lb. | | 5.50 | 5.75 |
| Sulphuric ($H_2SO_4$) 66° tank cars | ton | 15.00-16.00 | .. |
| Tartaric | lb. | .37 | .37½–.40 |
| Alcohol, denatured | gal. | .. | .41 |
| Aluminum hydrate ($Al(OH)_3$) | lb. | .04½–.05 | .05–.05½ |
| Aluminum oxide ($Al_2O_3$) | lb. | .. | .07 |
| Ammonium bifluoride ($NH_4$) FHF | lb. | .. | .21–.23 |
| Ammonia water ($NH_4OH$) 26° drums | lb. | .. | .03¼ |
| Antimony, metallic (Sb) | lb. | .. | .13 |
| Antimony oxide ($Sb_2O_3$) | lb. | .. | .15¾–.17 |
| Antimony sulphide ($Sb_2S_3$) | lb. | .14 | .15 |
| Arsenic trioxide ($As_2O_3$) (dense white), 99% | lb. | .03¾ | .04 |
| **Barium carbonate ($BaCO_3$)** | | | |
| Precipitated | ton | 53.00 | 58.00 |
| Natural, powdered, imported | ton | 48.00 | 50.00 |
| Barium hydrate ($Ba(OH)_2$) | lb. | .. | .. |
| Barium nitrate ($Ba(NO_3)_2$) | lb. | .08¼ | .08½ |
| Barium selenite ($BaSeO_3$) | lb. | .. | .. |
| Bone ash | lb. | .05 | .05½ |
| Borax ($Na_2B_4O_7.10H_2O$) | lb. | .04 | .04¼–.04¾ |
| Boric acid ($H_3BO_3$) | lb. | .. | .08–.09 |
| Refined | lb. | .08–.08¼ | .08½–.08¾ |
| **Cadmium sulphide (CdS)—** | | | |
| Red | lb. | .. | 1.20 |
| Orange | lb. | .. | 1.10–1.25 |
| Yellow | lb. | .. | 1.20–1.40 |
| Chromium oxide ($Cr_2O_3$) | lb. | .27 | .28 |
| Cobalt oxide ($Co_2O_3$) | | | |
| In bbls. | lb. | .. | 2.10 |
| In 10 lb. tins | lb. | .. | 2.20 |
| Copper oxide | | | |
| Red ($Cu_2O$) | lb. | .. | .30 |
| Black (CuO) | lb. | .. | .25–.30 |
| Black prepared | lb. | .. | .30 |
| Cryolite ($Na_3Al\ F_6$) Natural Greenland Kryolith) | lb. | .. | .09½–.09½ |
| Artificial or Chemical | lb. | .. | .09½ |
| Epsom salts ($MgSO_4$) (imported) Per 100 lb. | | 1.10–1.20 | 1.30 |
| **Feldspar—** | | | |
| 100 mesh | ton | 11.00-20.00 | 16.00-22.00 |
| 80 mesh | ton | 13.50 | .. |
| 40 mesh | ton | 12.50 | 13.50 |
| Fluorspar ($CaF_2$) domestic, ground, 95–98% (max $SiO_2$, 2½%) | | | |
| Bulk, carloads, f.o.b. mines | ton | 32.50 | .. |
| In bags or barrels | ton | 36.50 | 41.50 |
| Formaldehyde | lb. | .09¾ | .10 |
| Graphite (C) | lb. | .. | .04–.07 |
| **Iron oxide—** | | | |
| Red ($Fe_2O_3$) | lb. | .. | .02–.03½ |
| Black (FeO) | lb. | .. | .. |
| Kaolin (f.o.b. mine) | ton | 10.00 | .. |
| English, lump, f.o.b. New York | ton | 13.00-23.00 | .. |
| Kryolith (see Cryolite) | | | |
| Lead chromate ($PbCrO_4$) | lb. | .. | .. |
| Lead oxide ($Pb_3O_4$) (red lead) | lb. | .10 | .10¼ |
| Litharge (PbO) | lb. | .09 | .09¼ |
| **Lime—** | | | |
| Hydrated ($Ca(OH)_2$) (in paper sacks) | ton | 12.50 | .. |
| Burnt ($CaO$) ground, in bulk | ton | 9.00 | .. |
| Burnt, ground, in paper sacks | ton | 11.00 | .. |
| Burnt, ground, in 280 lb. bbls. | Per bbl. | 2.15 | 2.30 |
| Limestone ($CaCO_3$) | | 2.00 | .. |
| **Magnesia ($MgO$)—** | | | |
| Calcined, heavy (in bbls.) | lb. | .04 | .04½ |
| light (in bbls.) | lb. | .22 | .24 |
| extra light (in bbls.) | lb. | .. | .37 |
| Magnesium carbonate ($MgCO_3$) | lb. | .06 | .08½ |
| Manganese 85% ($MnO_2$) | lb. | .04½ | .05 |
| Nickel oxide ($Ni_2O_3$), black— for nickel content | lb. | .. | .35 |
| Nickel monoxide ($NiO$), green— for nickel content | lb. | .. | .35 |
| Plaster of Paris, bags | ton | .. | 19.00 |
| **Potassium bichromate ($K_2Cr_2O_7$)—** | | | |
| Crystals | lb. | .08¼ | .08⅝ |
| Ground | lb. | .11 | .12 |
| **Potassium carbonate—** | | | |
| Calcined ($K_2CO_3$) 96-98% | lb. | .06⅝ | .07⅛ |
| Hydrated 80-85% | lb. | .05⅝ | .06⅛ |
| Potassium chromate ($K_2CrO_4$) | lb. | .. | .27 |
| Potassium hydrate ($KOH$) (caustic potash) | lb. | .07⅛ | .08 |
| Potassium nitrate ($KNO_3$) (gran.) | lb. | .05½–.05⅞ | .05⅞–.06 |
| Potassium permanganate ($KMnO_4$) | lb. | .14 | .14½ |
| Powdered blue | lb. | .. | .24–.26 |
| Rochelle salts, bbls. | lb. | .. | .23 |
| Rouge | lb. | .. | .. |
| Rutile ($TiO_2$) powdered, 95% | lb. | .15-.20 | .20-.25 |
| Salt cake, glassmakers ($Na_2SO_4$) | ton | 22.00 | .. |
| Selenium (Se) | lb. | .. | 2.10-2.15 |
| Silver nitrate ($AgNO_3$) | oz. | .. | .41 |
| **Soda ash ($Na_2CO_3$) dense, 58%—** | | | |
| Bulk, on contract | Flat per 100 lb. | 1.22½–1.27½ | .. |
| In barrels | Per 100 lb. | 1.55–1.57½ | 2.40 |
| In bags | Per 100 lb. | 1.37½ | .. |
| Spot orders | .05 per 100 lbs. higher | | |
| Sodium bichromate ($Na_2Cr_2O_7$) | lb. | .06¼ | .06¾ |
| Sodium hydrate ($NaOH$) (caustic soda) | Per 100 lb. | .. | 3.50 |
| **Sodium nitrate ($NaNO_3$)—** | | | |
| Refined (gran.) in bbls. | lb. | .03¾ | .04 |
| 95 per cent. | Per 100 lb. | 2.65 | 3.00 |
| Sodium selenite ($Na_2SeO_3$) | lb. | .. | 2.35 |
| Sodium fluosilicate ($Na_2SiF_6$) | lb. | .04¾ | .05 |
| Sodium uranate ($Na_2UO_4$) Yellow or Orange | lb. | .. | 1.25 |
| **Sulphur (S)—** | | | |
| Flowers, in bbls. | Per 100 lb. | 3.45 | 3.80-4.00 |
| Flowers, in bags | Per 100 lb. | 3.10 | 3.45-3.65 |
| Flour, heavy in bbls. | Per 100 lb. | 2.85 | 3.20-3.40 |
| Tin chloride ($SnCl_2$) (crystals) | lb. | .46½ | .47 |
| Tin oxide ($SnO_2$) in bbls. | lb. | .69 | .71 |
| Uranium oxide ($UO_2$) (black, 96% $U_3O_8$) 100 lb. lots | lb. | .. | 1.25-2.25 |
| Zinc oxide ($ZnO$) | lb. | .06½ | .07 |

# Monthly Summary of United States Foreign Commerce in Glass

## EXPORTS

**Corrected to May 24, 1927**

| | April 1926 Quantity | April 1926 Value | April 1927 Quantity | April 1927 Value | Four Months Ending April 1926 Quantity | Four Months Ending April 1926 Value | Four Months Ending April 1927 Quantity | Four Months Ending April 1927 Value |
|---|---|---|---|---|---|---|---|---|
| Glass and glass products (total) | ..... | $780,710 | ..... | $766,421 | ..... | $2,870,609 | ..... | $2,892,206 |
| **Plate and window glass—** | | | | | | | | |
| Window glass, common, box 50 sq. ft. | 2,312 | 13,829 | 3,071 | 15,795 | 13,371 | 69,112 | 6,942 | 40,855 |
| Plate glass, unsilvered, sq. ft. | 49,520 | 18,732 | 80,673 | 36,245 | 502,553 | 110,845 | 437,887 | 129,586 |
| Other window and plate glass lbs. | 248,983 | 24,369 | 305,497 | 33,531 | 743,662 | 72,657 | 1,319,460 | 117,179 |
| Glass containers (bottles, vials and jars) | ..... | 234,337 | ..... | 266,367 | ..... | 892,545 | ..... | 942,499 |
| Table glassware, plain | ..... | 165,924 | ..... | 139,786 | ..... | 526,722 | ..... | 514,015 |
| Table and other glassware, cut or engraved | ..... | 32,126 | ..... | 13,753 | ..... | 66,413 | ..... | 43,795 |
| Lamp chimneys and lantern globes lbs. | 176,093 | 36,594 | 187,062 | 34,362 | 765,126 | 145,545 | 734,587 | 149,799 |
| Globes and shades for lighting fixtures lbs. | 126,848 | 43,416 | 127,009 | 51,157 | 556,366 | 181,284 | 536,779 | 206,919 |
| Chemical glassware lbs. | 20,486 | 16,120 | 17,010 | 17,566 | 79,631 | 72,212 | 54,163 | 52,853 |
| Electrical glassware, except for lighting lbs. | 367,209 | 48,057 | 129,623 | 14,117 | 1,717,743 | 166,228 | 784,117 | 79,180 |
| Other glassware | ..... | 147,206 | ..... | 143,742 | ..... | 567,046 | ..... | 615,520 |

## IMPORTS

**Corrected to May 24, 1927**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Glass and glass products | ..... | 2,096,841 | ..... | 1,337,826 | ..... | 6,640,049 | ..... | 5,502,227 |
| **Cylinder, crown and sheet—** | | | | | | | | |
| Unpolished dut. lb. | 7,788,144 | 363,522 | ..... | ..... | 23,607,811 | 1,081,722 | ..... | ..... |
| Weighing less than 80 pounds per case dut. lb. | ..... | ..... | 5,432,397 | 129,672 | ..... | ..... | 17,512,674 | 452,843 |
| Weighing 80 pounds or over per case dut. lb. | ..... | ..... | 3,042,779 | 128,895 | ..... | ..... | 13,808,636 | 645,955 |
| Bent, ground, beveled, colored, painted, etc., and polished dut. | ..... | 54,512 | ..... | 26,177 | ..... | 189,280 | ..... | 138,504 |
| Plate glass dut. sq. ft. | 3,318,110 | 1,100,386 | ..... | ..... | 9,503,209 | 3,102,112 | ..... | ..... |
| Polished, unsilvered dut. sq. ft. | ..... | ..... | 1,486,940 | 404,667 | ..... | ..... | 5,615,076 | 1,779,814 |
| Other plate glass dut. sq. ft. | ..... | ..... | 71,534 | 30,756 | ..... | ..... | 336,595 | 98,936 |
| Containers—bottles, vials, etc. dut. | ..... | 17,787 | ..... | 15,139 | ..... | 93,130 | ..... | 70,613 |
| Table and kitchen utensils dut. | ..... | 5,901 | ..... | 4,399 | ..... | 19,753 | ..... | 37,141 |
| Glassware, cut or decorated dut. | ..... | 205,428 | ..... | 285,368 | ..... | 768,560 | ..... | 1,080,909 |
| **Blown glassware, n. e. s.—** | | | | | | | | |
| Bottles, ornaments, etc. dut. | ..... | 75,468 | ..... | 66,205 | ..... | 284,122 | ..... | 242,341 |
| Bulbs for electric lamps dut. | 2,461,311 | 26,590 | 1,390,654 | 9,259 | 7,209,696 | 83,581 | 5,578,765 | 50,026 |
| Chimneys, globes, shades, etc. dut. No. | ..... | 90,562 | ..... | 73,564 | ..... | 358,204 | ..... | 286,957 |
| Articles and utensils for chemical, scientific, and experimental purposes dut. | ..... | 44,588 | ..... | 46,894 | ..... | 183,055 | ..... | 166,935 |
| Other glassware dut. | ..... | 112,097 | ..... | 116,831 | ..... | 476,530 | ..... | 451,253 |